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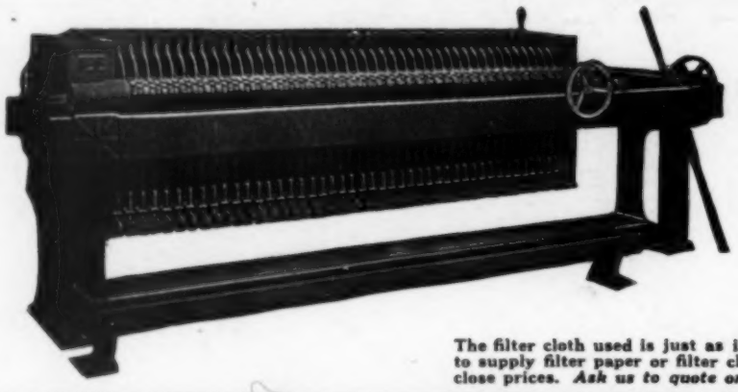

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CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor

Volume 28 | New York, February 14, 1923 | Number 7

The Real Need for Aggressive Leadership

RECENTLY we have had some clear thinking and straight talking about international relations and this country's responsibility in the present European situation. It is especially significant that it is the voice of American business that is most insistent in its demand that our government should no longer seek to avoid its moral obligations to the rest of the world.

One of the most recent names to be added to the growing list of American business men who have protested our ineffective foreign policy is that of A. C. BEDFORD, chairman of the board of the Standard Oil Co. of New Jersey. Not long ago in the course of an address before the Merchants' Association in New York he laid the blame for our vacillating course squarely at the door of the "partisan political controversies which have driven us as a people into a position with reference to the rest of the world that is contrary to the sentiments and traditions of our country."

The real need of the moment is for aggressive leadership, and there are few that will disagree with Mr. BEDFORD that this must come from Washington.

> We are entitled to look to our government for leadership and guidance in this great crisis. We feel that it is of utmost importance that matters of such supreme and transcendent consequence should be considered by the American people and the American Government from the American standpoint and without regard to partisan political considerations.
>
> We business men appreciate fully all the difficulties which confront the administration, but we feel that we can unhesitatingly assure our government at Washington that the most aggressive leadership will be welcomed by the whole American people and supported by the irresistible forces of intelligent public opinion.

If such leaders cannot come from among those in our government who have guided our foreign policies in the past, it is not unreasonable to believe that organized American business will unofficially, but none the less effectively, assert itself in the interest of peace and order in Europe. In fact had not the last Paris Conference of Allied Premiers already been called for Jan. 2, it is not at all unlikely that American business through the agency of the Chamber of Commerce of the United States might have taken a hand in an effort to straighten out the reparations tangle. On Dec. 25, 1922, the German Industrie- und Handelstag, the leading commercial body of Germany, invited the Chamber of Commerce of the United States to appoint a commission to investigate and express American opinion on the subject of German reparations. This evidence of confidence on the part of the leading commercial body of Germany in a similar organization in this country was sympathetically received, and the invitation probably would have been accepted but for the fact that it was considered proper to suspend decision pending a possible settlement at the Paris conference. Events following the failure of the diplomats to reach an agreement moved with such swiftness and in such unexpected directions that hope of further action by the Chamber of Commerce of the United States is now rather remote. The incident is noteworthy, however, as indicating sentiment on both sides of the ocean that the time is not far distant when the business man will be asked to take a more active part in solving the political as well as the purely business problems of international relations.

Education Of the Intuitions

IN THE current issue of *Engineering Education*, the president of Antioch College, ARTHUR E. MORGAN, declares that the chief defect in technical education today is the failure to educate the intuitions. By intuitions he means the ideas that seem to spring into being spontaneously and do not come as the result of conscious reasoning. Mr. MORGAN begins by acknowledging the debt that education and our modern engineering world owe to conscious reasoning and scientific analysis—a debt that is monumental and undisputed. But he points out that these rationalistic activities, which have built up the astonishing materialistic civilization that we now enjoy, are but tools by which intuitive purposes are accomplished.

All of us, he asserts, including engineers, live in the main by intuition. When we choose a wife, select a home, make friends or vote as a citizen, our intuitions generally control us. Yet the technical schools give students the impression that professional life is largely a succession of analytical processes. "As a matter of fact, in the professional work of most engineers who have gone beyond the stage of routine computers, decisions which must be arrived at by intuition both outnumber and outweigh those which can be reached by a purely technical approach."

President MORGAN continues: "Intuitions are not vagrants, arriving from nowhere and without cause or parentage. Rather they are normal and natural offspring, to some extent of heredity, but in very great measure of education and environment. . . . To the extent that the student's attention at college is confined to a consideration of technical principles and processes, his intuitions, outside of these phases which technical training specifically develops, will remain narrow, instinctive, primitive and crude, and made up of comparatively few factors."

Intuition is an important source of knowledge, a source too often overlooked. It is true, as President MORGAN declares, that most of us make important decisions by use of intuition. We decide by its aid whether

or not to accept offers and opportunities, whether a new acquaintance is worth trusting or not, and what personal policy to pursue. EMERSON pointed out that most of our mistakes come from not following our intuitions, and that life's most difficult problem is in deciding in what proportions to mix intuition and rationalism. He personally advocated more intuition and less rationalism. The distinguished French philosopher BERGSON has taught similar principles.

Without doubt the ancient and medieval wise men trusted intuition too much and rationalism too little. But perhaps in our reaction away from mysticism and *a priori* judgments we have emphasized rationalism at the expense of intuition. We are even apt to belittle or forget the fact that many great contributions to science probably came from *a priori* ideas. Such a hard-headed and mathematical-minded scientist as JOHN DALTON is said to have got his great idea on the atomic theory more by intuition than rationalism. That is, he got the idea before he made the experiments; as a laboratorian he was what we should call a "sloppy chemist." How many of the great discoveries and inventions in science have probably come by flashes of insight (intuition) rather than by cold reasoning! Yet to hear many college lecturers expound their scientific methodologies, a student would be led to think that there is no such thing as intuition, and that professional life is entirely applied rationalism.

Should we not then admit the importance of intuition, and see that teachers of engineering are broad minded and philosophical enough to develop its use? President MORGAN suggests that this should be done by mixing cultural and technical teaching, not by keeping them in watertight compartments. The great need is for professors of engineering who are at the same time cultured and philosophical men of the world.

An Immigration Policy In the Making

NOT long ago the National Association of Manufacturers decided it was time to answer the question: What shall we do about immigration? The opinions of representative industrial leaders, farmers, bankers and economists were sought and their replies furnished the basis of an interesting discussion in the current number of the association's magazine, *American Industries*. As might have been expected, there was a unanimity of opinion that the present quota law is wholly unsatisfactory. But the symposium also brought out sufficient constructive criticism to form the basis for a sound and permanent immigration policy.

All of the replies to the association's inquiry have been summarized in a number of recommendations which will be found on page 327 of this issue. Among these are the proposals that the quotas should refer to the net immigration from any particular country and that in case of labor shortages in this country the Secretary of Labor should be authorized to bring about the admission of desirable immigrants. It is further recommended that registration, distribution and education of the incomers should be handled by a centralized bureau or commission with the idea that these processes could thus be carried out more expeditiously and at the same time in a more humane way. It was almost unanimously agreed that the literacy test should be abandoned and that in its place we should have a scientific selection of our prospective citizens made by American officials on the other side of the ocean.

It is gratifying to learn that the effect of these recommendations has already been felt and that some of them probably will be incorporated in a measure soon to come up for Congressional consideration. Members of the House Immigration Committee have agreed among themselves on several basic principles that will underlie any revision of the present immigration law. Although these plans would call for a 2 per cent quota based on the number of foreign nationals residing in this country in 1890 (instead of 3 per cent in 1910 as at present), it is claimed that such a law would be so liberalized as to make it possible to bring in 200,000 more aliens than are now admitted. This would be accomplished by broadening the executive powers of the Secretary of Labor and increasing the number of exemptions to the present quota classifications.

It is apparent that the change from the 1910 to the 1890 basis would have the effect of sharply reducing the quotas allotted to Italy, Greece and southeastern Europe, without materially affecting those of the northern European countries that in the past have furnished us with a more desirable type of immigrant. Certain features of the proposed bill, however, will require further classification and perhaps will have to be modified considerably. For example, the flexible provision authorizing the Secretary of Labor to extend quotas when necessary is now so worded as to apply only to skilled labor and accordingly would not be effective in relieving shortages of common labor such as are currently reported in the steel industry.

This much, however, can be said in favor of both the association's proposals and the committee's tentative bill: They mark the first step toward establishing a definite immigration policy for the United States. If this policy is to be a lasting one, it must be designed to serve the economic and social interests of the country as a whole—without giving favor to either manufacturing or laboring classes.

Twelve Months' Armistice In the Coal Industry

THE coal stock report just issued by the Department of Commerce and U. S. Geological Survey shows an encouraging increase in the supplies of bituminous coal on hand the first of January, as compared with the stocks 2 months before. Despite large winter demands and active business conditions, the supply has evidently slightly exceeded the consumption so that 36,000,000 tons is now on hand in the commercial stocks of the country. This is a sufficient excess above the minimum safe stock, approximately 20,000,000 tons, so that there need be no fear of serious coal shortage this winter.

It has recently been announced also that wage agreements between mine operators and bituminous coal miners will be perfected for the coal year beginning April 1. Thus the industry declares another 12-month armistice in the wage wars which have threatened to wreck not only that industry but all of the rest of American business. In the meantime, the coal "fact-finding" commission will have completed its studies and reported to Congress on the remedies for the persistent and recurring troubles incident to coal shortages.

It has been many months since industry has been able to look forward as comfortably to as regular fuel supply as is now assured for the next year. Within that year it is certainly to be hoped that a permanent solution will be found of the problems of this basic industry.

What Makes a Good Journal Bearing?

IT MIGHT be assumed that the problems connected with bearings and bearing metals have been solved. On the one hand, mechanical engineers have constructed roller and ball bearings, assembled with a watchmaker's precision, or installed very effective systems of forced lubrication for the older types of journal bearings. Metallurgical problems might also be thought to have vanished, since specifications and foundry practice on babbitt, railroad "brasses" and bearing bronzes have been little changed for years. However, new metallurgical problems are continually cropping up and are being given careful consideration. To cite only three: How far can hardness in a bearing race be sacrificed to machinability? What is the best bearing metal for alloy-steel shafts in high-speed automobile or airplane engines? What kind of metal should aluminum castings or forgings rub against?

Theoretically, the load on a journal should be borne by an oil-film. Practice sometimes falls far short of this ideal, but all the progress that has been made in the mechanical and metallurgical construction of bearings has been effected by providing this minutely thin film more perfectly and more continuously. In view of its tremendous importance, we might pause to ask, Who is pressing a systematic, scientific research on the physical and chemical properties of lubricants? But that inquiry would lead us far afield, so for the present let us consider the effect of those undoubted metallurgical factors which come into play when the oil film is temporarily broken—chiefly when the shaft is starting or stopping its motion.

Experience had developed several highly successful bearing alloys long before modern metallography showed us that each was comprised of an aggregate of dissimilar crystals having a marked difference in hardness, plasticity and resistance to wear. The hard ones support the journal when metallic contact exists, and at such times they must be hard enough to support the load and yet not hard enough to score the shaft. The softer constituents wear away slightly faster and leave pocks for the lubricant. They always contain a minute amount of oil, but a quantity so necessary to prevent seizing during those critical periods when the journal is just starting or when enduring a momentary overload. It has also been found that successful bearings of long life almost invariably polish the journal during "running-in," and in turn the journal polishes the bearing. Now, bearing in mind that diamond dust will polish diamond, but no matter how worn it is, it will not polish emerald, it is apparent that the hardest constituent of the bearing must be of the same order of hardness as the journal which runs in it. Of course if a journal were glass hard and were mechanically and geometrically perfect it would run in any true bearing, but imperfections in alignment and finish are always greater than the thickness of the oil films; consequently in practice incipient wiping and polishing of one on the other always results. Sometimes the harder crystals in a bearing actually fuse on their surface to an observable extent during the preliminary "running-in."

For several years past a research committee of the American Society of Mechanical Engineers has been considering problems allied to the main question, "What makes an excellent bearing?" Early in their investigations they concluded that the literature was so contradictory it could not possibly be harmonized. Furthermore, they were of the opinion that experience furnished the only criterion of a successful bearing. If a number of satisfactory combinations of bearing and journal (and some unsuccessful ones as well) could be collected, the next step would be to study the hardness, orientation, melting point and relative amount of the various micro-constituents of both pieces. In other words, the utmost resources of modern metallography must be brought to bear on the problem in order to duplicate the successful combinations unerringly, and as certainly avoid the failures.

The first steps have been brilliantly successful. They have devised a beautiful instrument of precision (called by the ugly word "micro-character"), whereby a jewel point, 1,000 times sharper than the finest cambric needle, is drawn across a polished surface, ploughing a tiny groove in the crystals of the alloy of a width depending upon the hardness of each constituent. Its use has already cleared up several puzzling anomalies. Tin oxide crystals more than twice as hard as martensite have been found in poorly cast, oxidized bronzes—evidently such a bearing would score any journal. One babbitt analysis (Sn 90, Cu 10 per cent) contains crystals of $SnCu_4$, harder than cold-drawn shafting of low-carbon steel, and contrary to the theory of babbitting and the general impression among engineers harder than anything yet found in bronze. Nevertheless, that is the reason this particular babbitt is most unsatisfactory with soft steel journals.

However, the problem has outgrown the resources of the committee. It will be necessary, therefore, if the work is to continue, to put a competent investigator at work in some institution like the Bureau of Standards studying the intimate metallurgical details of many tried and true bearings now existing. In view of the importance of accurate knowledge about bearings to railroads, machine tool builders, engine and pump manufacturers, the automotive trade and the makers of bearing metals, the necessary funds will doubtless be forthcoming without extensive solicitation. Enlightened selfishness demands that the metallurgists in these industries get behind the most excellent program proposed by the Mechanical Engineers' committee—the results of the study will return their cost over and over again, like perpetual compound interest. Many a "hot box" has cost more than the expense of the research for a month.

A Protest From Germany

THERE has come to our desk a 28-page pamphlet containing a reprint of articles recently appearing in the *Chemiker-Zeitung*, by Dr. W. A. DYES of Berlin, relative to Mr. NEGRU'S articles on conditions in Europe. It is a protest against almost everything that Mr. NEGRU has said about Germany. The author marshals no fewer than ninety-seven references to other authors or publications whose expressions regarding Germany evidently please him better than did those appearing in this magazine. It is another example of the unwillingness or inability of the German mind to admit that Germany did anything during the years 1914-1918 to lose the confidence and respect of the other civilized nations of the world, or that in her evasion of the terms of the treaty of Versailles and the general conduct of her economic affairs in the past 4 or 5 years she has immeasurably delayed a return to world-wide peace and prosperity. The editor of *Chemical Age*, London, has appraised the value of Dr. DYES' pamphlet so fairly that we publish his comment elsewhere in this issue.

Readers' Views and Comments

Costs of Producing Natural-Gas Gasoline

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have carefully looked over the costs of producing natural-gas gasoline as given in the manuscript you kindly sent for my inspection[1] and I believe that the figures are approximately correct. However, I should change the cost of construction of a high-pressure absorption plant with a capacity of 10,000 gal. per day from the figure Mr. Sievers uses—namely, $450,000 or $500,000—to $200,000 to $300,000. Also I should change the cost of a charcoal plant of 4,000 gal. a day capacity from $90,000 to $125,000. I happen to be building one of about this size at the present moment, and I think this latter figure is more nearly correct.

The reason I am suggesting that the 10,000 gal. per day absorption plant be reduced is that I am familiar with some very recent developments whereby it is claimed a 6,000-gal. oil-absorption plant can be built for only $100,000. This plant embraces some new improvements, and while I am a little skeptical about the figure, yet it is probably not far from the actual cost.

It might be pointed out that while the cost of operation of the compression plant showed 11c. per gallon, this includes a very large sales cost, whereas apparently the absorption plant cost of 6½c. per gallon, which Mr. Sievers mentions, does not include sales. At the present moment the production at the compression plant he cites is about 5,200 gal. a day, and the costs have been reduced through various economies and larger gallonage to about 8½c. a gallon.

Pittsburgh, Pa. GEORGE A. BURRELL,
Petroleum Engineer.

What Is Steel?

To the Editor of Chemical & Metallurgical Engineering

SIR:—In my opinion this question—What is steel?—has been treated in a most masterly way by the late Dr. H. M. Howe in the chapter on Classification and Nomenclature of his book, "The Metallography of Steel and Cast Iron," in which he shows that historically and logically we seem to be forced to use a classification based on origin; and, according to the practice generally used in all but the Teutonic countries, the present industrial classification is satisfactory and sufficient except for blister steel and ingot iron. In accord with this system is Dr. Matthews' definition of steel: "Steel of commerce is that form of iron which has been produced by melting to yield a finished product which is malleable."

Dr. Howe considered a structural classification not practical; nevertheless, if it be considered desirable to distinguish between low-carbon steel and ingot iron, which difference Dr. Matthews' definition ignores, this may be done metallographically, since it so happens that cementite appears to be soluble in ferrite over the carbon range embraced by ingot iron. Thus, up to a content of 0.03 per cent carbon, according to H. Scott (*Chem. & Met.*, Dec. 13, 1922), its existence is not detected by thermal or microscopic means, or A_1 is absent in ingot iron and of course also in electrolytic iron and in much wrought iron. The other elements, manganese, sulphur, silicon, etc., which may also be present, need not be considered in the definition, since they may be classed as constituents of, or impurities in, either iron or steel.

On the high-carbon side, there does not appear to be as sharp a demarcation between steel and cast iron, for example, as appears to exist between ingot iron and steel.

Your proposed definition, "Steel is a malleable alloy of iron and iron carbide," may be ambiguous with respect to wrought iron.

Recognizing the disappearing product known as blister steel as an anomaly, Dr. Matthews' definition may be modified to eliminate ingot iron: "Steel of commerce is that form of iron which has been produced by melting to yield a malleable, finished product in which iron carbide can be detected."

Bureau of Standards, Washington, D. C. GEORGE K. BURGESS,
Chief, Division of Metallurgy.

Problems in the Production of Sodium Sulphide

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to the editorial on "Sodium Sulphide" in your issue of Jan. 10, this company has produced sodium sulphide both by the direct method and as a byproduct from the barium industry. While we believe the barium industry is permanent in this country, still you are correct in saying the sodium sulphide derived therefrom cannot be regarded as a basic source, because at the very best it is variable. Regarding the direct method, what you say is very true indeed. It is our belief that any great improvement in the direct process must of necessity get away altogether from either reverberatory or rotary furnaces. However, experiments along this line we think should be confined solely to the amount anyone can afford to lose on a venture.

Rollin Chemical Corporation, South Charleston, W. Va. JAMES B. PIERCE, JR.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have noted with interest your editorial in the Jan. 10 issue regarding the manufacture of sodium sulphide. This problem is indeed an intricate one and one to which manufacturers have given serious thought. A process with a low per cent yield of the soda input is one which offers a big chance of improvement and, at the same time, the rough semi-skilled labor necessary, which continually grows harder to obtain, also makes improvement necessary.

Seemingly all attempts at improvement have met with only meager success, both in this country and abroad. Careful temperature control would aid greatly, but to simplify this for operation by the class of labor necessary presents a difficult problem in that no suitable recording instrument has yet been found which stands up under the furnace conditions. Again, impurities entering the crude product from the furnace walls, etc.,

[1] This article by E. G. Sievers appears on pp. 297-8 of this issue of *Chem. & Met.*

tend to make filtration of the solution of dissolved sulphide melt impossible, and here again a difficult problem is met.

The production of a fluid melt which could be run directly from the furnace into water, forming an immediate solution, would cut down subsequent crushing and handling costs, but to obtain proper fluidity, the amount of the reducing medium, such as coal screenings, has to be lessened to such an extent that proper reduction does not take place and again one is baffled. Finally, a large stack loss is also entailed in the present process which presents a problem where a saving could be made.

It is believed, however, that in time these problems will be solved as this one of the crudest processes in the inorganic chemical industry must of necessity be eventually improved.

Further comments on your editorial will be interesting. ARTHUR L. GARDNER.

Merrimac Chemical Co.,
Everett, Mass.

Long-Term Credits and The Fertilizer Industry

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to your editorial in the Jan. 10 issue, entitled "Long-Term Credits and the Fertilizer Industry," the facts as you state them are essentially correct, but the conclusion at which you arrive is not a practical possibility, if for no other reason than that it undoubtedly would be held to be an agreement in restraint of trade. CHARLES H. MACDOWELL,

Chicago, Ill. President, Armour Fertilizer Co.

To the Editor of Chemical & Metallurgical Engineering

SIR:—I read your recent editorial entitled "Long-Term Credits and the Fertilizer Industry" with a good deal of interest. You are quite right in saying that long-term credits is one of the very serious problems of the industry, and you could safely have added that it is also one of the most pernicious practices. However, I hardly think this practice was started with a view of increasing the tonnage already established, but on the other hand I think it was more to induce the use of fertilizer where it had not been used before. Now that its use has passed the experimental stage, it seems to me high time for the industry to change its selling policy.

Years ago the average farmer looked on a sack of fertilizer as being nothing more than a bag of sand through which a polecat had been drawn, but since that time our agricultural colleges have established without question the value of fertilizer and have convinced the intelligent farmer it is as necessary for him to feed his plants as it is for him to feed his stock if he hopes to get best results.

You are right in saying that competition is one of the causes of long credits. Some fertilizer concerns, in their anxiety for tonnage, seem to have little if any regard for the credit risk involved, and apparently are willing to give almost any credit terms, merely to effect a sale, with the result that the fertilizer industry has really been playing the part of banker to the farmer. However, the industry is endeavoring to get away from this practice, with the hope of putting the business on a cash basis, as it should be.

Cottonseed meal is rarely, if ever, sold on other than cash against documents terms, even though it is used by the farmer as a fertilizer, and yet that same farmer, who would willingly pay cash for his meal, nitrate of soda and other fertilizer materials, balks when it comes to paying cash for his manufactured fertilizer.

Another bad feature about long-term credits is that a great many merchants were really averse to handling fertilizer, but did so in order to get the other business of the planter. However, to get this business they used the fertilizer as a leader and sold it at practically cost to them, thereby losing the interest on the money they advanced to pay the freight (where freight was not prepaid) and also receiving nothing for their trouble and expense in handling the goods. The result was, when their notes for this fertilizer became due, they figured that the fertilizer end of the business was the last thing to be paid, for the reason that they themselves made no profit out of it, which, of course, was a poor excuse.

Again, country merchants, who could not borrow money from a bank without putting up ample security, bought fertilizer on credit and sold it out at its exact cost for cash, which money they used in their business without interest from date of shipment until May 1 (the usual settling date). Then when they settled on May 1, they would give their notes due in the fall, said notes including interest from May 1 to maturity, without any security whatever. When these notes matured, the merchants seemed to feel that they were the last things to be paid, and in many instances it was with great difficulty that collection of them was effected.

In the southeast Atlantic states the custom has been to prepay freights on shipments of fertilizer. This means that the fertilizer manufacturers have not only extended credit on their goods, but they have loaned the country merchant the money (without interest) with which to pay the freight. The reason this pernicious practice was started was competition. However, it did not reach what is known as the Southwestern territory —that is, the Southern section west of the Mississippi River—until the last few years, when it was introduced by the packers at the time they entered this field.

The industry has made greater strides in the last 2 or 3 years toward putting the business on a cash basis than ever before, and banks throughout this territory are beginning to recognize the fact that they must assist in carrying the credit risk, and therefore a number of them are now beginning to make loans to farmers to enable them to buy fertilizer, and the fertilizer industry is helping this along by offering very attractive discounts this year. E. K. HUEY.

American Cotton Oil Co.,
New Orleans, La.

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to your recent editorial, the manufacture of sodium sulphide still remains, so far as I am aware, just about where it was in Weldon's time. During the 25 years that I have been interested in it, the slight attempts that have been made toward improvement have left the process just about where it was. Mr. Gardner's letter to you enumerates some of the difficulties that have been met. The men who did much of the work many years ago are no longer with us. The results were negative and the details of the work done are lost. I am quite convinced that any real improvement in manufacture must be along lines radically different from any that have as yet come to my attention. F. G. STANTIAL.

Merrimac Chemical Co.,
Woburn, Mass.

British Chemical Industries

FROM OUR LONDON CORRESPONDENT

LONDON, Jan. 18, 1923.

ALTHOUGH the political situation in Europe gives rise to anxiety, the general improvement that has taken place in the chemical trade during the last few months is still maintained and prices as well as business both for home and export account are increasing slowly but surely. It is perhaps premature to form any opinion as to the effect of the occupation of the Ruhr upon specific industries, but it is fairly clear that the coal and the iron and steel trades will improve, at any rate temporarily. The textile trades continue very firm and have helped to maintain stability in chemical markets. The prices of German fine chemicals will presumably advance in the near future, and it almost seems as if the British fine chemical industry, which, as previously noted in these columns, has been more or less moribund for a long time past, will experience something of a revival. There is also a distinct improvement in the sales of dyestuffs.

GOOD COAL AND OIL PROSPECTS

Cheap coal has always been a prime necessity for this country, but although the output is almost at its maximum, having regard to the 7-hour day, and pithead prices are only about 60 per cent above pre-war, freight and other expenses are up about 90 per cent. Pressure has been brought to bear upon the railways to reduce freights, but so far without success. Nevertheless, a reduction is confidently expected in the late spring and if it should also be possible to induce the miners to revert to the 8-hour day, that would make all the difference in enabling the heavy influx of orders to be filled and in giving the necessary impetus to the chemical and allied industries.

Fuel oil continues to gain favor and low-temperature carbonization of certain cannels and other low-grade coals is showing a progressive increase, probably because such installations do not depend upon the sale of smokeless solid fuel. Very substantial progress has been made in low-temperature retorting, and active developments are reported in the distillation of shales, torbanites, lignites and the like.

INDUSTRIAL AND TECHNICAL DEVELOPMENTS

The past year has not been very prolific as regards the introduction of new processes, and that may have to some extent been due to the natural reluctance of manufacturers in hard times to encourage expenditure on hypothetical schemes. The outlook and position is now changing and quite a number of promising developments are under way. Mention might be made of the tendency to import liquid rubber latex instead of crêpe and of two processes using latex, the one giving cold vulcanized products practically without odor and without brittleness in the cold, and the other enabling practically the whole of the constituents of the latex to be imported in solid or pasty instead of liquid form, thus saving freight yet enabling the essential parts of the latex to be reconstituted for manufacturing processes after arrival. As mentioned in last month's notes, the process for coagulation of blood and tankage by means of suitable reagents is now being tried out and phonograph records, cotton spinners' bobbins, waterproof paper, electrical goods and buttons may be instanced as probable applications. English patent 165,832 indicates that the blood is heated for about 24 hours at about 50 deg. C., preferably in a closed vessel, and the aëration is carried to such a point that coagulation to a stiff jelly can be effected in about 2 hours by adding 2 to 4 per cent of 40 per cent formaldehyde or ½ per cent of caustic soda. Alternatively the blood may be injected in a thin stream into hot water containing coagulating reagents, and it is stated that the cost of manufacturing material that would be suitable for molding purposes is about 3c. per pound. In referring to development and new inventions your correspondent has often been struck by the fact that business trips to Europe would be more profitable in every way if made in the spring instead of being combined with a vacation during the "rush" period. In the summer business topics are at a discount in spite of numerous "prospects" from America, and firms would do well to consider carefully planned winter or spring trips instead, preparing the ground beforehand by correspondence and representatives' reports.

GENERAL NEWS AND NOTES

The Society of Chemical Industry's new weekly journal *Chemistry and Industry* has, on the whole, been favorably and tolerantly received and is already showing signs of improvement. A not unexpected feature is the indirect advertising that the society has received by providing a general topic of conversation. The *Chemical Age* has now incorporated the monthly *China Clay Trade Review* and in view of the revival in this industry and its close connection with many chemical works, the moment seems opportune.

The public is taking considerable interest in the official inquiry as to charging for gas by its thermal value and a few recent accidents have produced much unjustifiable criticism of carbon monoxide content and its dangers. The tendency is still for a reduction in gas prices and for an increase in the declared calorific value.

E. V. Evans has resigned his appointment as a member of the Dyestuffs Advisory and Development Committees and his place has been taken by Mr. Dawson, manager of the British Alizarine Co., and Mr. Blundell, of the North British Chemical Co., Ltd., respectively. Dr. Carpenter has resigned from the Council of the A.B.C.M. (Association of British Chemical Manufacturers) and Dr. Clayton, M.P., succeeds him.

The death of Prof. George Lunge at Zurich is a reminder of the great debt which the chemical industries of all countries owe to this literary pioneer and inventor. It may be of interest to know that one of his sons is head of the development department of Courtaults, Ltd.

The Institution of Chemical Engineers is now definitely in being and the first batch of members has already been elected by the Council. Reciprocal arrangements have been made with the American Institute of Chemical Engineers for attendance at meetings and in regard to proceedings; applications for membership already exceed two hundred.

Your correspondent regrets an unfortunate error in quoting prices for pitch in last month's notes. The price a few months ago should read $12.50 and the level in December was $28. As anticipated, prices have slightly increased since to $30.

The Dollars and Cents Of Careful Barrel Handling

Although the Wooden Barrel Was Invented Far Back Before the First Dawn of Written History, Little Is Known by the Average User as to the Proper Care to Give Them When Handling and Storing — Some Startling Figures Are Presented Showing the Money Involved

By Matthew William Potts
Consulting Engineer, New York City

THERE is no doubt that the chemical and allied industries of this country are the greatest users of wooden barrels, and this includes what is known as tight and slack cooperage. I have been in plants where the plant managers and purchasing agents are not familiar with the meaning of the terms tight and slack cooperage, and yet they are using hundreds of barrels per day. This lack of knowledge goes right down through the organizations and is the cause of much abuse to the barrels, loss of materials through leakage, contamination of contents, etc., which amounts to thousands of dollars per year.

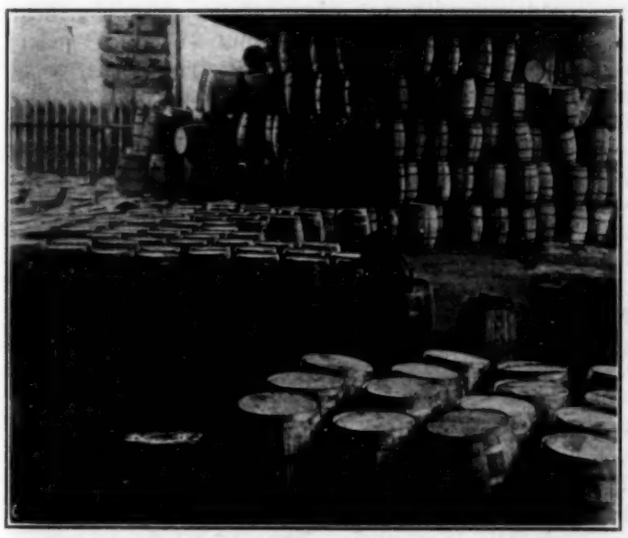

FIG. 1—EXAMPLE OF POOR EMPTY BARREL STORAGE

Recently a large chemical company contemplated the use of bilged steel barrels as shipping containers for its products. These barrels were to be billed to the customer with a refund, providing they were returned to the company. This system is now in use by a number of large chemical industries, but it has nearly as many disadvantages as the old wooden barrels.

Upon investigation, the chemical company of which I speak found that most of its trouble was due to its own carelessness in the handling and storage of the wooden barrels, both before and after filling. After correcting a few of the most flagrant cases of barrel abuse it was found unnecessary to provide a returnable container system and in this way an investment of money amounting to over a hundred thousand dollars was saved.

In another plant it was found that by properly storing the wooden barrels, both before and after filling, a cheaper grade of barrel could be used. This change in grade made a saving of 45 cents per barrel. The company was using approximately 200 barrels per day, 300 days per year, so this small saving per barrel amounted to $27,000 per year in barrel costs alone. There were additional savings in labor costs for repairing and coopering, claims on carriers and delays to customers.

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"Barrels Are Not Well Made Any More"

The common complaints against the wooden barrels of today are: the wood dries out, hoops fall off, heads break in, liquid contents leak out between the staves, at the bung and around the croze of the barrel. These complaints are summed up by plant managers and purchasing agents in the statement, "The barrels of today are not properly made."

Replacing heads, putting on new hoops, coopering and recoopering are expensive. Leakage of contents amounts to a loss of thousands of dollars every year to manufacturer and consumer alike, but why place all the blame against the barrel manufacturer? Experience proves that leaks are caused more frequently from abuse (many times unintentional) than from improper manufacture. Barrels are most frequently ruined at the users' plant while empty. Fig. 1 illustrates a very frequent example of barrel abuse.

In the first place the storage location is improper. It is under a viaduct where rain and snow can beat in from either side, and there is a continual circulation of air. Drip and drainage from the viaduct falls down on the heads of the barrels, causing them to swell. When the photograph was taken the sun was beating down on the barrels as shown to the left. They are

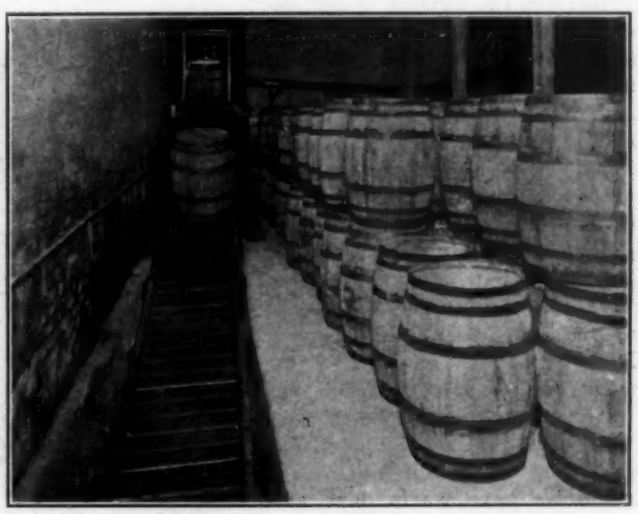

FIG. 2—EXAMPLE OF GOOD EMPTY BARREL STORAGE
Also shows barrels being handled by means of slat conveyors and gravity conveyors. (Courtesy Matthews Gravity Conveyor Co.)

FIG. 3—STEAMING THE BARRELS SO AS TO FORM THE BILGE
(Courtesy Cleveland Cooperage Co.)

practically unprotected and the alternating wetting and drying out of the wood has a disastrous effect. By looking closely, a number may be seen where the hoops have fallen off, one has only the two head hoops remaining. Considering that these barrels had been in storage only a week when the photograph was taken, they are in poor condition.

The Barrel Manufacturer Is Careful of Stock

To appreciate why a barrel should be protected it is helpful to give a little detail as to the method of manufacture. From the very start, great care is taken to remove just the right amount of moisture from the lumber. The rough staves are usually stored in the open for a year to season. Before they are ready to assemble into a barrel they are put into a hot room or dry kiln to evaporate the remaining moisture. To make the bilge, steaming is necessary, but this slight addition of moisture is later removed by firing. (See Figs. 3 and 4.)

This dryness of the barrel makes the staves and heads equivalent to blotting paper, with an affinity for moisture. This is the reason why the inside of the barrel is sized (or lined) if it is to be used as a container for liquids or pastes. If the absorption of moisture from the outside is not excessive, is constant and of an even temperature, the barrel will not be damaged. However, when moisture has been absorbed and subsequently evaporated, leaks will develop, because the swelling of the barrel has expanded the hoops and they do not return to their original diameter to hold the joints tight.

This is the reason it is necessary to store barrels in a proper location, under cover and in an even temperature. Extreme variations in temperature will open the joints. This trouble is experienced in March and April, when we have warm days and cold nights. This causes the staves and heads to expand during the high temperature in the day and there is no corresponding shrinkage of the hoops at night.

Fig. 2 illustrates a good empty storage and a good method of handling barrels. The features to note are the clean, dry, well-ventilated room where the barrels are kept, the even piles, the spacing so that the top ones are not resting on the heads of those beneath, but are resting on the chimbs with four points of contact and support. Also all hoops are tight and in proper place.

The handling of barrels is often considered of no importance because they are provided with a bilge which makes them easy to roll. This general practice or method is not recommended except where a track or runway is provided so that it is possible to get two points of contact near the quarter hoops. Fig. 2 shows an ideal way of handling barrels by means of an apron conveyor, or elevator, and gravity conveyors. Another means is by electric storage battery lift truck that transports the barrels from place to place and also elevates them for piling. The careless dropping of a barrel, if even for only 6 inches, is likely to break a stave, and to roll them on the bilge, allowing them to bump one another with force, has a tendency to spring the staves and produce leakers, especially if the barrels are packed with liquids or pastes.

Taking a little more care in barrel handling will be found a profitable investment. When unloading from trucks or automobiles the barrels should be lowered by means of skids. When being tiered they should be raised and lowered by means of portable elevators. When the barrels are to be transported for a long distance the track runway will be found very advantageous. This track or runway is simple in construction and consists of two strips of wood or small iron rails spaced approximately 18 in. apart. The writer has seen barrels filled with liquids rolled for a distance of a quarter of a mile and then turned at right angles to the first run

FIG. 4—FIRING THE BARRELS TO REMOVE THE MOISTURE ABSORBED WHILE STEAMING
(Courtesy Cleveland Cooperage Co.)

and rolled for an additional distance of over a thousand feet. In the entire length of this runway only two men were required to handle the barrels. One man was stationed at the right-angle turn and the other man patrolled the entire runway, so that when a congestion at any point made it necessary to stop the barrels he stopped them gently and did not permit them to bump together. In this way it was possible to load cars quickly and economically, as many as eight cars being loaded at a time.

The High Art of Coopering

Barrels are often ruined when they are being filled. They are almost always improperly coopered. These two points can be given very careful consideration. When barrels are to be filled with liquids, more care is required than if they are to be filled with a powdered or lump material. First the hoops should be driven tight. It is best to do this coopering by machinery as shown in Fig. 5, as barrel coopering is an art that few men understand and the machine coopering has been perfected to eliminate the human element. If, however, the number of barrels is small, hand coopering can be used and at all times the employing of an experienced cooper will be found economical, although it will be necessary to pay him more wages than an ordinary laborer.

For hand coopering and other purposes every barrel user should supply the cooper with the proper tools, which include a cooper's hammer, chimb maul and bung reamer. In addition, the cooper should have on hand at all times a supply of bungs, flag, pegs, extra heads and extra hoops. The hoops on a barrel should be tightened by light taps around the barrel and not by a hard blow at any one point. If the barrels are slippery, lump chalk should be used for better friction until hoops are in final position and fastened.

No matter what the product is, a barrel should never be completely filled. Ample room must be allowed for expansion. Some barrel users leave out a gallon in a 50-gal. barrel and smaller sizes proportionately. Others stop filling when the liquid is within 2 or 3 in. of the bung hole. Of course some liquids have a greater tendency to expand than others, which prevents giving a universal rule to follow, but care should be taken in this respect and the filler should adopt a safe, conservative policy covering this important point. Where barrels are filled by removing one head, as in the case of dry products, heavy pastes, etc., care must be exercised in replacing the head so that it fits square in the croze or groove. A leak in the croze (where head and staves come together) usually indicates a poor fit and can generally be stopped by hammering the outside of the barrel at that point until the head falls into place.

The final job of bunging up the barrel is often badly done. Putting in the bung is very simple, but it must be done right. First soak the bung in hot water so that it will expand quickly after it is driven in. Then insert it part way to make sure that it exactly fits the hole. If it is too tight, ream out the hole just a trifle with the proper tool. If it is too loose, wrap it with a piece of cloth, or preferably use a large bung. The final driving should not be done until the grain of the bung runs parallel with the grain of the stave (to avoid breakage), then hammer it "home" and turn the barrel to test for leakage. If it holds tight, seal the bung with a bung seal, or strap, and the job is properly done.

A number of chemicals are packed in the form of fine powder and it has been found that in order to save the leakage of content, no matter how well the barrel is made, it is necessary to remove one of the heads before filling and to insert a paraffine paper bag liner. The contents are then packed into this paper bag within the barrel, the top of the bag is drawn together and tied, the head replaced and the barrel is ready for painting and shipping. At this point there is overlooked an important help to the customer—namely, the marking of the head that has been removed so it will be possible for him to open the proper end of the barrel, so that when he has removed only a portion of its contents he can again tie the bag. This marking can easily be taken care of by having the cooper when he removes the head (before filling) nail a small embossed disk on the upper side. This disk can be about an inch in diameter and carry the words, "Open this end." Then when the head is replaced after the barrel has been filled there is no guessing as to which end to open.

After Filling and Before Shipping

Every barrel upon being filled, whether filled with liquids, lumps or powder, should have the hoops driven tight and nailed down with fasteners, or cleats, or dented into the wood with a sharp tool. This holds the hoops firmly in place against jolts and rough handling. Each hoop should have at least two nails or dents, one on each side of the barrel, and these should be placed only after the final driving of the hoops.

Painting of barrels is done for two reasons. First, to provide a protective coat for the wooden heads and staves, and second, to give a neat appearance to the package and to serve as an advertisement for the company whose products it contains. The painting and marking of barrels is according to the taste of each individual user. Some like blue barrels with white

FIG. 5—DRIVING THE HOOPS BY MACHINERY
Note the number of grips on the hoops. This drives the hoops even and with just the right pressure.

heads, carrying a stenciled trade mark and the necessary shipping marks such as "Net, Tare and Gross" weights. Others like a red barrel with a white band around the center or bilge. The decorative effect is not so important as the proper time and method of painting. In a number of cases the barrels are painted before filling, but I believe the time to paint a barrel is just prior to shipment. The paint then acts as a protective coat, as it is fresh, and the slight addition of moisture swells the staves just enough to keep the hoops tight while in transit.

Machine Painting Often Economical

The method of painting depends upon the number being shipped per day. If this exceeds fifty, the use of machine equipment will be found economical. When the barrels are painted before filling, a revolving machine is the most advantageous, but when the barrels are filled and then painted, an air brush equipment with a revolving, lift turntable, will be found most satisfactory.

An investigation made by the writer gives the following comparison between the hand and machine methods of painting barrels as follows:

Data	Hand	Air-Brush
Number of men on painting operation	2 or 3	1
Number of hours worked	9 to 12	9
Average man-hours per day	18	9
Wages per man-hour	$0.45	$0.55
Average labor cost per day	$8.10	$4.95
Average number barrels possible to paint per day	175	175 plus
Cost for paint per month	$211	$110
Cost for brushes per month	18	0
Maintenance and operation per month	0	15
Depreciation per month using 15 per cent	0	$13.64
Total cost for 25 working days	$431.50	$262.39

Net savings due to air-brush methods $169.11 per month.

Over and above the direct money savings is the speeding up of the work, a neater and cleaner painting space and general better working conditions.

The grade of paint to be used is also a matter of personal choice, but it must be remembered that your barrels in transit are a good source of advertisement and it is well to give them a good coat of paint and to use care in selecting distinctive colors. For ordinary commercial purposes, I would suggest either a paste, barrel paint, thinned with rosin oil or gloss oil, or a cheap dry earth paint mixed with rosin oil. The rosin oil can be purchased or can be made by pulverizing 3½ lb. "F" grade rosin and adding 1 gal. of naphtha. Apply heat, stirring until dissolved. This mixture should be kept in a covered receptable, as it evaporates quickly.

The common blue and white combination on staves and heads requires a paint mixture of 5 lb. dry paint with 1 gal. of rosin oil. If red or yellow is preferred, 3 lb. paint with 1 gal. of rosin oil. Raw naphtha should not be used for thinning, as it will make the surface dull or flat. When using the air-brush method of painting, the above specifications should be submitted to the manufacturer of the air-gun and should be approved by him before being used in the equipment.

The marking or tagging of barrels for identification is a problem on which many users have spent considerable time and money without obtaining satisfactory results. A covered envelope made of paper and tacked to the head or side of the barrel is generally used. These tear off in storage and in transit. If wetted, the writing blurs and the identification of the barrel is lost. The most satisfactory method of marking is to use an embossed metal tag. The barrel will then practically have to be destroyed before it will lose its marking.

Effect of Manganese on Steel

A method of preparing very pure iron has been developed at the Bureau of Standards and with this iron as a base various steels and other iron alloys have been made for the purpose of testing them without the complicating effect of impurities which are usually present in commercial iron and steel.

The use of manganese in steel as a strengthening agent in addition to the carbon is the chief subject of the investigation described in Scientific Paper 464 from the bureau, entitled "The Effect of Manganese on the Structure of Alloys in the Iron-Carbon System."

The use of higher percentages of manganese for producing high tensile properties in low- and medium-carbon steels has been recommended at times by various metallurgists, and to some extent such recommendations have been carried out in commercial practice. The results obtained in this investigation of the structural effects of manganese in steel strongly confirm such recommendations concerning this use of the element.

The general effect of manganese may be concisely described as a "restraining influence" so that the pearlite, even after annealing, exists in very fine-grained condition if considerable manganese is present. In this respect the steel resembles in structure and mechanical properties the condition which usually obtains in similar steels of low manganese content after rather rapid cooling—for example, air-cooling.

Manganese also appears to have a very noticeable effect upon the rate at which high-carbon steels, such as carbon tool steels and file steels, assume the granular or "spheroidized" state—a condition which for many purposes is very desirable. Manganese exerts its characteristic retarding influence upon this change.

Quarry Operators Should Apply Engineering Principles

"During recent years I have visited about 600 stone quarries," states Oliver Bowles, mineral technologist of the Bureau of Mines. "Many of these quarries are highly efficient operations, but on the other hand I find some processes in use that are as crude as those employed in Egypt when the pyramids were built. The employment of inefficient methods is due partly to lack of capital, partly to tradition or to the influence of methods used in surrounding operations, and partly to unusual quarry conditions, but one great outstanding lack is the failure to apply the principles of engineering to the problems encountered. Some problems may require the experience and knowledge of a trained engineer, and he should be called in consultation. In many instances, however, the operator is quite capable of solving his own problems by applying to them two important engineering principles. The first principle is the ability to see both sides of a question, to weigh the evidence impartially, and to dismiss from consideration any preconceived opinion as to the most desirable solution of the problem. The second important principle is the establisment of conclusions on a sound basis of fact. Thus the preparation of positive data is a necessary function of any investigator, and this can be done only by keeping exact records of tonnage and costs. Few economic problems can be solved without using figures, and no quarryman can hope to solve his problems without the aid of systematic records. Many processes now in use would be abandoned tomorrow if the operator had before him figures indicating their excessive cost."

Cost of Producing Natural-Gas Gasoline

The Scope of the Industry Is Briefly Outlined and Recovery Costs for Various Types of Plants Are Carefully Analyzed

By E. G. Sievers
Washington, D. C.

FROM experimental production on a small and crude scale in 1900 to an output of 450,000,000 gal. in 1921 is the story, in brief, of the growth of the natural-gas gasoline industry in the United States. The first plant was constructed in Pennsylvania in 1904, but not until 1910 did the industry assume commercial importance. The production of natural-gas gasoline has made marked progress since 1915, due to the development at that time of the absorption process, which made it possible to remove the gasoline from dry gas and also to treat a much larger quantity of gas.

In 1911 the total output in the United States was 7,425,000 gal., but the annual production since then has increased rapidly. The output in 1921 was 596 per cent greater than that of 1911. Table I shows the production from 1916 to 1921 inclusive, and Table II shows the output in 1921 by states.

Gasoline is recovered from natural gas by two chief methods—namely, by compression and absorption. The compression method is applied to wet gas or that having a high gasoline content, whereas the absorption process is used for dry gas yielding less than 1 gal. of gasoline per thousand cubic feet of gas. Absorption plants are now largely replacing compression plants because the absorption product is more stable and demands a higher price. Present-day practice, however, has shown that the combination of compression and absorption plants is very successful, consequently many of the operators are combining these processes. About 75 per cent of the total annual output is produced at the compression plants.

One of the vital problems in the production of natural-gas gasoline is that of plant efficiency. Many plants are today operating under conditions not in conformity with good conservation practice. The producers, however, are mindful of this fact and are constantly working toward greater improvements. According to data compiled by the United States Geological Survey the yield of gasoline per thousand cubic feet of gas in 1921 was nearly 0.2 gal. greater than in 1920. In Table I it will be noted that there has been an annual increase in yield since 1916.

The economic importance of natural-gas gasoline is better appreciated when it is realized that it constitutes nearly one-tenth of all the gasoline produced annually in the United States. Natural-gas gasoline is highly volatile and therefore is blended with naphthas or refinery gasolines in preparation for the market. This is an economic factor in that the blending makes it possible to utilize large quantities of naphthas at the refineries otherwise having little commercial use. In view of the constantly increasing demand for motor fuels, the production of natural-gas gasoline must of necessity continue to be one of our essential industries.

Because of the rapid growth of the industry, due perhaps to the increasing demand for gasoline, not enough attention has been paid to the costs of construction and operation of plants. The greatest expansion of the industry came during the war when manufacturers were able to market their product at almost any price. Consequently there was little necessity for careful analyses of costs. The manufacturers were making good profits and, furthermore, were too busy solving mechanical problems to give more than cursory consideration to the matter of costs. The depression following the war demoralized prices, and made it difficult for the natural-gas gasoline manufacturer to locate a market. As a result there was greater scrutiny in business methods and costs, and at the present time every effort is being made to put the industry on a firm basis.

One of the first steps necessary was to combine

TABLE I—NATURAL-GAS GASOLINE PRODUCED IN THE UNITED STATES, 1916-1921
(Data Compiled by the United States Geological Survey)

			Gasoline Produced			Gas Treated (Estimated)		
				Value				
Year	No. of Operators	No. of Plants	Gal.	Total	Average (Cents)	M. Cu.ft.	Value*	Average Yield of Gasoline per M. Cu.ft. (Gal.)
1916	460	596	103,492,689	$14,331,148	13.8	208,705,023	$14,609,300	0.50
1917	750	886	217,884,104	40,188,956	18.4	429,287,797	34,343,000	0.51
1918	503	1,004	282,535,550	50,363,535	17.8	449,108,661	40,419,700	0.63
1919	611	1,191	351,535,026	64,196,763	18.3	480,403,963	41,314,700	0.73
1920	576	1,154	384,743,922	71,788,122	18.7	496,430,952	41,700,000	0.78
1921	458	1,056	449,934,402	61,815,258	13.7	479,618,194	41,500,000	0.94

* The value of the gas is based on sales to gasoline producers, not on sales for domestic and industrial purposes.

TABLE II—UNBLENDED NATURAL-GAS GASOLINE PRODUCED IN THE UNITED STATES IN 1920 AND 1921
(Data Compiled by the United States Geological Survey)

			Gasoline Produced			Gas Treated		Percentage of Total Production			
				Value				State		United States	
State	No. of Operators	No. of Plants	Gal.	Total	Average (Cents)	M. Cu.Ft.	Average Yield per M. (Gal.)	Compression	Absorption	Compression	Absorption	Total
1921												
Oklahoma	123	280	185,340,742	$22,066,014	11.9	88,380,173	2.10	89	11	49.9	16.7	41.2
Texas	24	65	77,141,201	9,118,420	11.8	26,460,805	2.92	89	11	20.6	7.3	17.2
California	29	73	58,220,498	9,874,594	17.0	69,356,048	0.84	63	37	11.1	18.1	12.9
West Virginia	66	179	54,646,053	9,889,861	18.1	135,483,171	0.40	31	69	5.0	32.2	12.2
Pennsylvania	170	264	19,856,373	3,354,233	16.9	46,336,174	0.43	58	42	3.5	7.1	4.4
Louisiana	13	26	15,340,374	1,812,268	11.8	45,543,846	0.34	46	54	2.1	7.0	3.4
Wyoming	6	7	14,557,684	1,599,591	11.0	4,559,639	3.19	99	1	4.4	0.1	3.2
Ohio	27	48	9,099,897	1,546,551	17.0	35,888,504	0.25	18	82	0.5	6.3	2.0
Illinois	34	90	7,536,073	1,101,227	14.6	3,102,246	2.43	100	....	2.3	....	1.7
Kentucky	8	9	4,241,938	834,983	19.7	16,520,224	0.26	5	95	0.1	3.4	0.9
Kansas	9	11	3,587,329	565,408	15.8	7,784,339	0.46	42	58	0.4	1.8	0.8
New York	4	4	366,240	52,108	14.2	203,025	1.80	100	....	0.1	....	0.1
Total, 1921	458	1,056	449,934,402	61,815,258	13.7	479,618,194	0.94	73.9	26.1	100.0	100.0	100.0
Total, 1920	576	1,154	384,743,922	71,788,122	18.7	496,430,952	0.78	73.1	26.9	100.0	100.0	100.0

small unprofitable plants into fewer large plants. It is recognized that profits on plants producing less than 1,000 gal. of gasoline per day are very uncertain. The overhead expenses, the difficulties of marketing a comparatively small quantity of gasoline, and the fact that these small plants require as much attention as large plants have proved that even under favorable conditions they are not particularly profitable. This is especially true with plants which have been installed to handle a much larger volume of gas than is now available. There are today many plants heavily overequipped with machinery, making the maintenance and depreciation charges on such properties greatly out of proportion to the gasoline produced and the revenue derived.

This condition was largely brought about by overbuilding prior to and during the war. During this time a large number of plants with the intrinsic weakness of insufficient permanent supplies of gas were installed in various parts of the country. The gathering lines of these plants in many instances overlapped the lines of other gasoline plants, so that at present the plant capacity far exceeds the gas now available.

TABLE III—COST OF CONSTRUCTING A COMPRESSION PLANT IN 1919-20

Compressors and engines	$33,000	Gathering lines	$50,000
Freight, hauling and setting compressors	10,000	Electrical equipment	1,000
Buildings	5,000	Switch and loading rack (and tankage at loading rack)	15,000
Condensors	5,000	12-mile pipe line to loading rack	40,000
Accumulator tanks	1,000	Water supply	5,000
Auxiliary engine, pumps, etc.	3,000		
Storage tanks	25,000		
			$193,000

TABLE IV—COST OF CONSTRUCTING AN ABSORPTION PLANT

Absorbers and accessories	$12,000	Railroad switch	$2,000
Pumps	2,000	Buildings	5,000
Compressor (direct connection)	4,000	Boilers	10,000
Still	1,400	Labor	20,000
Oil separator (on gas line)	500	Tools	3,000
Condensor boxes and coils	1,000	Electrical equipment	1,500
Storage tanks	10,000	Grading, draining, ditching	1,000
Loading rock	500	Main lines around plant	5,000
Oil coolers	3,500	Meters, thermostats, and laboratory equipment	500
Heat exchangers	4,500	Building materials	10,000
Site	500	Contingent	10,000
Water supply	3,000		
			$110,900

In the older fields where the gas supply has declined greatly, manufacturers have found that to dismantle many of these plants or to convert them into vacuum or booster stations does not involve a large expenditure. Natural-gas gasoline manufacturers interested in the consolidation of plants and the change of processes have carefully calculated the cost of diverting gas from small to large plants, and of changing the process from compression to absorption, and have found that in most cases it is more profitable to consolidate the plants and change to the absorption process.

The cost of constructing gasoline plants naturally fluctuates according to the cost of material, labor, transportation, etc. The location of the plant, the quality of the gas to be treated, and the capacity of the plant, are factors in determining the cost of installing the plant. If the location of the plant is a considerable distance from a railroad the cost will be appreciably higher. Table III shows the cost of constructing a compression plant in the Appalachian field in 1919 and 1920. This plant could be built at a very much lower cost today. Furthermore, it was built during a period of bad weather, when bad roads were a serious handicap. The plant treats 1,100,000 cu.ft. of natural gas a day and yields as much as 4,500 gal. of gasoline a day.

The cost of labor is included. The cost of operation, including overhead expense, sales, depreciation, interest, depletion and freight is in the neighborhood of 11 cents a gallon.

Production of a plant has little relation to the cost of construction. The cost of installing a plant producing 1 gal. of gasoline to 1,000 cu.ft. of gas would be very little less than for one having a higher production.

An absorption plant having a daily capacity of 20,000,000 cu.ft. of gas and producing about 4,000 gal. of gasoline at high pressure will cost approximately $110,900. This cost is analyzed in detail in Table IV.

It will be noted that this amounts to $27.50 per gal. capacity per day. An absorption plant with a capacity of 1,000 gal. per day would cost about $40,000, and one with a capacity of 10,000 gal. per day would cost from $450,000 to $500,000.

Pressure is an important item in connection with cost. An absorption plant producing 4,000 gal. of natural-gas gasoline per day at 10 lb. pressure would cost from $175,000 to $200,000.

An absorption plant using the charcoal method can be operated successfully regardless of pressure. Such a plant producing 4,000 gal. of gasoline a day would cost approximately $90,000.

The cost of operating an absorption plant having a capacity of 4,000 gal., and costing $110,000 to construct, is as follows:

Interest, 6 per cent	$6,600	Sales expense	5,000
Depreciation, 10 per cent	11,000	Insurance and taxes	3,000
Labor	13,000	Fuel, natural gas at 50 cents per M cu.ft.	20,000
Repairs and supplies	10,000		
Tank-car rental	7,000		
Administrative expenses	14,000		
			$89,600

This is equal to about 6½ cents a gallon and may be considered a minimum for operating absorption plants in the Eastern fields.

Welding Pressure Vessels

One of the many difficult problems concerning the boiler code committee of the American Society of Mechanical Engineers in its effort to draw up satisfactory codes governing the construction of unfired pressure vessels was that of welding. Rules applicable to riveted constructions do not always apply to fabrication by welding.

The problem is seriously complicated because of the meagerness of scientific data upon which to base proper requirements for safety without placing unjust restrictions on the use of welding. Wide differences of opinion prevailed not only among the members of the committee, the insurance companies and inspectors, but also in the industry itself.

A hydrostatic and hammer test was finally proposed for determining whether a vessel was safe for the purpose designed. Eight manufacturers placed at the disposal of the committee about forty tanks and enough funds. These tanks have been tested to destruction by the U. S. Bureau of Standards. The shells of most of the tanks were 6 ft. long and 2 ft. in diameter, and made of ⅜-in. mild steel plate. Both electric and oxy-acetylene welding were used. The hydrostatic and hammer test developed that the welded pressure vessel, according to the regular formula for working pressure, has a factor of safety of about 6.

Our Broadening Knowledge of Lubrication

The Recent Chemical and Physical Researches That Have Given Us a Better Insight Into the Composition and Properties of Mineral Lubrication Oils Are Reviewed and the Main Paths for Future Study Are Indicated*

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DURING the last few years rapidly increasing attention has been directed by chemists and physicists to the study of lubricating oils. The former have attempted to obtain some knowledge of the various types of hydrocarbons in the oil and their physical and chemical characteristics; the latter have endeavored to elucidate the why and wherefore of lubrication and the most recent researches have tended to develop along the line of contact of the two sections of the investigation.

CHEMICAL COMPOSITION

The chief points so far elucidated regarding the chemistry of mineral lubricating oils are[1]:

(1) It appears beyond doubt that the high-boiling fractions of petroleum, irrespective of their place of origin, are complex mixtures containing but a small percentage of paraffine hydrocarbons of the formula C_nH_{n+2}, and consisting chiefly of compounds whose formulas range from C_nH_{n} to C_nH_{n-8}. A few of these compounds have been isolated by Mabery, by repeated fractional distillation of crude American oils, even from a crude so pronouncedly paraffinoid in nature as Pennsylvania oil.

(2) In no case has the chemical constitution of a component of a lubricating oil been established, but the chemical behavior of these oils indicates that among the components are unsaturated hydrocarbons (possibly open-chain but more probably naphthenic and polynuclear, or perhaps of both types), saturated hydrocarbons (naphthenic and probably to some extent polynuclear, but not to any appreciable extent paraffinoid), and aromatic hydrocarbons (to an unknown and probably a limited extent), together with small amounts of sulphur- and oxygen-containing compounds, the latter of which can be isolated and are probably the principal cause of gumming.

(3) "Unsaturated" compounds constitute between 20 per cent and 40 per cent of most lubricating oils, and are in part removed from the oil by agitation with concentrated sulphuric acid.

CHARACTER OF "UNSATURATED" COMPOUNDS

Brooks and Humphrey have shown that the higher simple olefines are polymerized by concentrated sulphuric acid yielding a colorless condensation product which is insoluble in the acid but soluble in hydrocarbons. Small amounts of carbinols, and acid and neutral sulphates are also produced. It follows, therefore, that the olefine contents of a hydrocarbon mixture cannot be determined volumetrically by extraction with sulphuric acid.

When lubricating oils are shaken with concentrated sulphuric acid, a heavy tarry mass separates which soon becomes solid. It seems doubtful, therefore, if lubricating oils contain more than a small percentage of true olefine hydrocarbons. This conclusion is strengthened by the fact that, so far as our experience goes, attempts to hydrogenate such oils by the Sabatier method have uniformly failed. It would therefore appear that the nature of the unsaturated bodies in lubricating oil is at present an unsolved problem.

A partial separation of these unsaturated hydrocarbons from the saturated ones which does not involve their destruction can be achieved by employing their superior solubility in liquid sulphur dioxide. Thus a lubricating oil with an iodine value of 46 on extraction with liquid sulphur dioxide gave a residue with iodine value 33 and an extract with iodine value 73.

A similar effect can be achieved by filtration through fullers earth, a material which adsorbs unsaturated compounds to a greater degree than saturated compounds. Neither method is sufficiently discriminating to be of use in effecting even an approximate separation of the two types.

The curious iodine value results given by lubricating oils seem to indicate that the unsaturated compounds attacked by sulphuric acid and by formaldehyde do not react readily or normally with iodine.

The reaction of mineral oils toward iodine differs profoundly from that of fatty oils. Experience in the determination of iodine values by means of Wijs' reagent has indicated that by varying the time and proportion of iodine chloride a given mineral lubricating oil may yield widely varying values. For example, a California mineral oil gave a value of 20 in 2 hours, 40 in 4 hours, 60 in 64 hours and 80 in 266 hours, whereas rape oil reached a steady value in 3 minutes. Again, the iodine value of rape oil was found to be practically independent of the amount of Wijs' solution used (provided a fair excess was employed), but with the mineral lubricating oil an increase in the proportion of reagent to oil invariably augments the iodine value.

The interpretation of these results is difficult when coupled with the reluctance exhibited to hydrogenation; unsaturated glycerides of comparable molecular weight behaved quite normally in both respects.

The facts again seem to lead one to the conclusion that the "unsaturated" hydrocarbons in mineral oil consist to a small degree only of true olefines. The sluggish reactivity of the greater part may be due to the somewhat slow and difficult rupture of closed ring systems, which can be brought about by the drastic action of sulphuric acid and Wijs' reagent respectively, whereas the milder action of hydrogen and nickel fails to operate.

NAPHTHENIC, AROMATIC AND RESINOUS COMPOUNDS

(4) Analysis indicates that the residual saturated compounds after treatment with concentrated sulphuric acid are principally naphthenic, and most probably polynuclear in structure, since they contain less hydro-

*A paper presented before the Petroleum Division of the American Chemical Society at Pittsburgh, Sept. 7, 1922.

[1] The present authors have on various occasions (*J. Inst. Pet. Tech.*, 1918, vol. 4, p. 191; British Association, Cardiff, 1920; *J. Inst. Pet. Tech.*, 1921, vol. 7, p. 417; British Association Colloid Committee, Third Annual Report, 1921) discussed the chemical composition of mineral lubricants.

gen than is demanded by the simple naphthenic formula, C_nH_{2n}.

(5) The presence of aromatic hydrocarbons is possible, but has not been definitely proved. By nitration, nitro-derivatives are obtainable; the reduction products from these will, however, not yield azo-dyes, so the nitro-compounds may not be aromatic in type.

(6) Resinous components have been shown by Holde to be present to the extent of a few tenths of a per cent, and to be capable of separation from the hydrocarbons by treatment with alcohol and ether. They are solid, oxygen-containing, lac-like bodies, and are probably an important cause of "gumming," since they would tend to accumulate as the hydrocarbons in the oil evaporated. Moreover, the hydrocarbons thus purified showed no tendency to gum on prolonged exposure to heat and air. Holde's statement would appear to go too far. The removal of these bodies reduced the gumming tendency. Removal of unsaturated hydrocarbons still further reduces it, but even the saturated hydrocarbons oxidize appreciably on exposure to air and heat.

Viscosity and Chemical Character

The actual influence on the viscosity of the oil of the differences in chemical nature of the different components has been stated by several workers, the statements being in some cases contradictory. Mabery and Mathews have published figures which indicate conclusively that an increase in viscosity occurs concurrently with a decrease in the hydrogen content, paraffines being comparatively very mobile and inefficient in lubricating powers, while hydrocarbons of the formula C_nH_{2n-4} are said to be as viscous and as efficient as sperm oil.

It is a well known fact that paraffines are comparatively poor lubricants, while oils such as medicinal paraffine and vaseline, which have been submitted to vigorous refining by acid or filtration generally with the object of decolorizing, are inferior in viscosity and in lubricating efficiency to those which still contain a certain proportion of unsaturated hydrocarbons. The oil refiner should therefore carefully regulate the treatment given so as to remove as far as possible the oxygenated compounds and the more highly reactive of the unsaturated hydrocarbons, which are chiefly responsible for gumming and carbonization, while destroying only a minimum of those more stable unsaturated hydrocarbons the presence of which in the oil is an asset.

Krämer and Spilker have synthesized condensation products from methylated benzenes and alkyl alcohol, which possess extremely high viscosity, and are in fact synthetic lubricating oils. For example, with mesitylene as a starting-out material, they have made:

$$(CH_3)_3C_6H_2-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-C_6H_2(CH_3)_3 \text{ or } C_{21}H_{28}\text{; i.e., } C_nH_{2n-14}$$

This compound has a specific viscosity of over 700. They consider that such bodies are the true "viscosity carriers" in lubricating oil and that the high viscosity is due to the accumulation of methyl groups.

R. H. Brownlee has recently shown that a hydrocarbon oil of high flash point and viscosity and very low cold test, suitable for lubrication, is obtained by the polymerization of light unsaturated hydrocarbons by agitating them with a catalyst preferably at 200 to 400 deg. F. As catalysts anhydrous aluminum chloride, or a halide or reagents which produce a halide in the nascent state, are used. The oil, after treatment, is washed and distilled with steam. The distillates include products having the flash points of naphtha and kerosene, and a variety of lubricating oil fractions.

(8) The influence of physical conditions on the viscosity of lubricating oils, especially as regards preliminary heat-treatment, was pointed out long ago by Bender, while the recognition of colloidal components in machine oil by Schneider and Just brought lubricating oils into line with other colloids as regards the well-known manifestation of temperature-viscosity hysteresis. Heavy mineral oils must undoubtedly be iso-colloids—i.e., polyphase systems in which the dispersed component is of the same chemical nature as the dispersion medium. Just as water must be regarded as a system in which molecules such as $(H_2O)_2$ coexist with simple H_2O molecules, so in a lubricating oil the disperse phase is a molecular aggregate suspended in a dispersion medium of simpler and similar structure.

The Property of "Oiliness"

(9) The vital importance of maintaining the film of lubricant between shaft and bearing necessitates that mysterious property known as "body." Perhaps no property has been discussed so assiduously among lubrication experts as this. Archbutt and Deeley refer to this as "oiliness" and indorse the opinion of Wilson that, in reality, oiliness or body is a function both of viscosity and of capillarity. Unfortunately there is little experimental record on the surface tension of mineral oils, but there is a very close relationship between the two properties to which reference has been made. Both are conditioned by the play of intermolecular forces, and both are intimately affected by association and unsaturation.

It is not improbable that some connection exists between body and molecular weight. When it is realized that the triglycerylester of ricinoleic acid, which is present in castor oil, has a molecular weight of 932, whereas that of Russian engine oil is 426, it is reasonable to expect a much higher value for the molecular volume in the fatty oil. This enhanced value shows itself not only in high viscosity but also in "oiliness."

Granted that lubricating oils are iso-colloids, it is possible that this mysterious oiliness or body may be dependent on the degree of dispersion exhibited by the particular oil.

In recent years the property of "oiliness" has become associated with the presence of unsaturated compounds which constitute 20 to 40 per cent of most lubricating oils.

W. B. Hardy concludes that lubrication depends wholly on the chemical constitution of a fluid; the fact that the true lubricant is able to render slipping easy when a film of only about one molecule deep is present on the solid faces suggests that the true lubricant is always a fluid which is adsorbed on the solid face, such adsorption being dependent on the attractive forces associated with unsaturated compounds. It follows that lubrication is merely a special problem of colloid physics. A surface saturated with a film of condensed matter (ordinary glass, for example, possesses a film of grease on the surface with a depth of $1\mu\mu$) differs from one with a cleaned or raw surface. The surface of water after scraping has a higher surface tension and is highly adsorptive. Vigorous rubbing of a glass surface under water with the finger tips until a clinging feel is produced yields a fresh surface which possesses peculiar

properties such as "seizing" when in contact with a similar fresh surface.

Deeley has measured static co-efficients of various oils between metals. When no lubricant is used the static co-efficient increases as the surfaces continue to rub against each other. Such clean surfaces are very sensitive to contamination influences—e.g., moisture. It is interesting to note that the oils which have the smallest coefficient of friction are those which have proved the best lubricants in practice. It would appear that the unsaturated molecules of the lubricant enter into a firm physicochemical union with the metallic surfaces, forming a friction surface which is a compound of oil and metal. This surface would also appear to be of more than molecular thickness. Thin films of this kind cannot be removed by merely wiping, but must be ground off under water, or a thin layer of metal must be cut off.

Fatty Acid Blending

H. M. Wells and J. E. Southcombe consider that the superiority of a blended or compounded oil is due to the presence of a small amount of free fatty acid, either pre-existing in the added saponifiable oil or formed therefrom by hydrolysis. They therefore propose to prepare lubricating oils by adding to mineral oils such a quantity as 1 to 2 per cent of free fatty acid. Acids of low molecular weight such as butyric and cinnamic acids results in the formation of a non-emulsifiable oil, while the acids of high molecular weight like those obtained from whale oil, wool grease, etc., form emulsifiable oils suitable for marine lubrication.

During the past year these workers have continued the development of their views on the influence of small amounts of fatty acids when dissolved in mineral oils. They emphasize the distinction between the lubrication of fast-running shafts with a large excess of oil, where the frictional values are a function primarily of the oil viscosity, and that of slow speed machinery with high bearing pressure, where viscosity measurements no longer assist in the choice of the lubricant. They have found that the interfacial tension against water of vegetable and animal oils was very much lower than that of a mineral oil, and this lowering was due to the slight content of free fatty acid in the fatty oils; by removing the free fatty acids from the saponifiable oils the tension rises, and by adding free fatty acids to the mineral oil the tension can be lowered. It follows that if a substance be added to an oil which brings about a lowering of interfacial tension, such addition will act favorably as far as lubrication is concerned by preventing a rupture of the liquid film and consequent direct contact between the metals.

In point of fact, Archbutt concludes from experiments which he has recently communicated to the Physical Society that the addition of 1 per cent of free fatty acids to a mineral oil lowers the frictional coefficient to the same extent as does 60 per cent of pure rape oil, and thus lends support to the contention that it is not the glyceride, but the free fatty acid in a compounded oil which improves its lubricating value. The theory that the action of the fatty acid is due to the fact that the interfacial tension between oil and water and between oil and mercury is greatly lowered by the addition of fatty acid to a mineral oil has met with criticism, and it has been pointed out that, although neutral rape oil added to mineral oil greatly reduced the friction coefficient, the interfacial tension between neutral rape oil and water was nearly as high as that between mineral oil and water. In the lubrication of a shaft or journal running at a fairly high speed and under moderate pressure, the bearing is separated from the journal by a film of oil, and the friction is solely due to the viscosity of the lubricant. That property of a lubricant which is not viscosity and is termed "oiliness" becomes important only when the conditions are such that solid or "contact" friction occurs, and all recent work points to the fact that it is the chemically reactive unsaturated constituents of lubricants which promote "oiliness" and that they do so by entering into physicochemical union with the solid faces lubricated, forming new composite surfaces with lower surface energy and opposing less resistance to shear than the unlubricated surfaces. The greater activity of free fatty acids is quite in accordance with this theory.

Our Knowledge of Vegetable and Animal Oils

(10) It will be manifest from the foregoing brief summary of our present knowledge on this subject that a very wide and extremely important and absorbing field of research is open not only with reference to mineral oils but including also the vegetable and animal lubricating oils and perhaps synthetic compounds of know composition and ascertainable lubricating efficiency.

The number of lubricating oils derived from vegetable and animal sources is limited, and the chemical constitution of these oils, with some exceptions, is fairly well known. They are composed of the esters of trivalent and monovalent alcohol radicles, containing saturated and unsaturated fatty acids. The particular esters contained in the different oils and fats have to a large extent been identified, and their quantitative proportions can in some cases be stated approximately. Further research is most needed in the case of the sperm oils, the particular alcohols and acids of which are still quite unknown. Castor oil also needs further investigation. The number of different esters in each vegetable and animal oil is comparatively small. The oil or fat yielded by each kind of seed or animal tissue is sufficiently uniform in composition for its lubricating value to be known from past experience. The knowledge that we lack in the case of these oils is the relative lubricating values of the individual esters composing them, and as all the natural oils are mixtures, it is desirable that the pure esters should be prepared and their lubricating properties determined.

With mineral lubricating oils the circumstances are entirely different. The number of these oils is very large, and our knowledge of their composition very incomplete. We know that they consist in the main of hydrocarbons of different series, some saturated and others unsaturated. We know broadly, but very incompletely, the principal series of hydrocarbons existing in the lubricating oils that are manufactured from the crude petroleum obtained from the different oil fields, but we have no knowledge of the quantitative composition of these oils nor of the chemical constitution of any of the particular hydrocarbons composing any particular oil. We are also possessed of very little information as to the relative lubricating values of the different series of hydrocarbons. If the number of mineral lubricating oils were as limited as that of the vegetable and animal oils, if they were definite products like the oils naturally occurring in vegetable and animal tissues, it would not be a difficult matter to learn by experience the lubricating values of the different oils, and a knowledge of their

constitution would then be of secondary importance to the user of lubricants. But the variety of mineral lubricating oils is so great and their composition so variable and so dependent upon the process of manufacture that it is a matter of the utmost importance for us to be able to analyze these oils. For this purpose it is desirable to determine the nature and relative proportions of their constituents, and also to separate the main constituents from each other and determine their relative values as lubricants.

A Suggested Research Program

The main lines on which research is needed may be summarized as follows:

(1) To isolate and determine the nature of the hydrocarbons in mineral lubricating oils which especially promote the properties of viscosity and "oiliness."

(2) To determine the classes of hydrocarbons desirable in lubricants required to work under high pressures and high temperatures, particularly as regards their relative stability under the conditions obtaining in internal combustion engines, steam engines and air compressors.

(3) To study the causes and means of preventing the formation of carbonaceous deposits from lubricating oils under the conditions named in (2), with special reference to the nature of the hydrocarbon and non-hydrocarbon constituents of such oils.

(4) To study the causes of emulsification in circulating oiling and in splash systems, with special reference to (*a*) the influence of the oxy- and thio-compounds in mineral oils, and (*b*) the characteristics of oils with non-emulsifying properties.

(5) To study the causes and conditions of oxidation of hydrocarbons at elevated temperatures.

(6) To determine the direction in which the processes of manufacture can be modified so as to lead to the production of lubricating oils of improved types.

(7) To discover new methods of analysis that will enable the chemist when examining a lubricating oil in the laboratory, besides determining its viscosity, specific gravity, flashpoint, etc., to determine the constituents of the oil and with the help of the knowledge gained under (1) to (5) to measure its ability to reduce friction and to meet the conditions of speed, load, temperature and atmosphere in which it is required to work. Much of this information can be ascertained today only by the costly method of trial.

(8) To elaborate further methods of producing lubricants synthetically in order to meet special requirements. Dicresyl-carbonate, for example, has been used as a lubricant. Reduced naphthenes, glycerides of naphthenic acids and cinnamenes have been prepared and shown to have lubricating value. It might be found possible to produce lubricants whose rate of change of viscosity is less and whose freezing point is lower than is the case with existing lubricants.

(9) To prepare in a pure state the esters met with in animal and vegetable lubricating oils and determine their relative lubricating values.

(10) To investigate the claim that the free fatty acids present in commercial fixed oils are the active constituents which enable these oils to improve the lubricating value of mineral oils, and to investigate further whether the addition of such acids to mineral oils may have any deleterious effect.

(11) To investigate the colloidal nature of lubricating oils and its bearing upon lubricating problems.

(12) To study the effect of ultra-violet light, sunlight and ozone upon lubricating oils.

(13) To investigate the phenomena of dissimilar surfaces (oil and metal) in contact, especially in relation to the property of "oiliness."

Testing Oiliness by Friction-Testing Machines

By Winslow H. Herschel
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Viscosity is the only property of a lubricant which lends itself readily to mathematical treatment and which is usually taken into consideration in investigations of the laws of fluid friction. Oiliness is a more elusive property, which has been defined as the property which causes a difference in friction when two lubricating oils of the same viscosity at the temperature of the oil film are used under identical conditions.[1]

Oiliness has little or no effect under conditions of complete film lubrication, but a change of bearing metal will produce a marked change in friction and of carrying power under conditions of speed and pressure when a change from one lubricant to another of the same viscosity will produce no effect. High pressures, wide clearance, low speeds or low viscosity have a tendency to produce a condition of incomplete film lubrication in which differences in the lubricant in regard to oiliness may be detected. It is generally recognized that fatty oils are superior to mineral oils in regard to oiliness, and hence fatty or compounded oils are in general use on gearing and for cutting oils.

There is coming to be a fair agreement that oiliness is due to some form of interaction between the lubricant and the bearing metal, although different investigators may speak of it as adhesion, adsorption or interfacial tension. There is therefore nothing illogical in the view of Von Dallwitz-Wegner[2] that oiliness is a joint property of liquid and metal, although varying only with the one if the other remains constant. In this paper it will be considered that the bearing metals are constant and that oiliness is a property of the lubricant.

Methods of Measuring Oiliness

Considerable work has been done in England in measuring oiliness by the use of special apparatus such as the Lanchester oil gear-testing machine[3], the Deeley oil friction-testing machine[4], and the interfacial tension apparatus of Donnan[5]. This last-named apparatus is open to the objection of making it necessary to assume that the relative interfacial tension between the lubricants and some liquid is the same as the relative tension between the lubricants and the bearing metal.

Bingham[6] suggests eleven different methods of measuring oiliness, the two most immediately available being the use of a lubricant as a cutting oil and the determination of the coefficient of friction of rest by the inclined plane. Wilson and Barnard[7] had the greatest success with the inclined plane and the Deeley friction machine, and also developed two new lines of investigation.

It was found that the flow through metal capillaries, under a constant head, decreased with time, this de-

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[1] Winslow H. Herschel, *J. Soc. Automotive Eng.*, vol. 10, pp. 31, 369 (1922).

[2] R. v. Dallwitz-Wegner, *Zeit. für techn. Physik*, vol. 2, p. 160 (1921) and vol. 3, p. 21 (1922).

[3] Report of Lubricants and Lubrication Inquiry Committee, pp. 50-79, 110-112; London, 1920.

[4] R. M. Deeley, *Proc.*, Physical Soc. London, vol. 32, part 2, p. 18 (1920); Report of Lubricants and Lubrication Inquiry Com., p. 101.

[5] F. G. Donnan, *J. Soc. Chem. Ind.*, vol. 39, p. 51T (1920).

[6] E. C. Bingham, Bu. Standards Technologic Paper 204, pp. 39, 49 (1922), and Fluidity and Plasticity, p. 271 (1922).

[7] R. E. Wilson and D. P. Barnard, 4th, *J. Ind. Eng. Chem.*, vol. 14, p. 683 (1922).

crease being the more rapid for oils of good oiliness. Similar observations were made by Fulweiler and Jordon[8] with glass capillaries, in investigating sources of error in viscosimetry, but they found that with some oils the flow increased with time. If it should be confirmed that the rapidity of clogging of metal capillaries is a measure of oiliness, this method is very promising as a routine test, because it could be readily standardized and does not necessitate laborious polishing and repolishing of metallic surfaces.

Wilson and Barnard give as a tentative conclusion that in tests with friction-testing machines the location of the point of minimum friction, or critical point, is "lowered by the oiliness of the lubricant." Any conclusion must necessarily be based upon the very meager data available. The literature is full of reports of inconclusive tests on friction machines, where unsuspected variations of roughness and of clearance between rubbing surfaces, as well as uncertainty in regard to the viscosity of the oil film, cause discordant results. It is believed that the following method of reporting tests is of general application and will make results of tests much more intelligible. The method has been used at the Bureau of Standards in an investigation of the possibility of measuring oiliness with an oil friction-testing machine, and it is hoped to report the results of this work in a subsequent paper.

Method of Reporting Results

It is now generally recognized that a journal is eccentric in its bearings, the eccentricity diminishing as the speed is increased. It is also known that the friction varies with the clearance and with the eccentricity, and according to Sommerfeld[9] eccentricity is a function of $\frac{\mu n d^2}{p \Delta^2}$, that is a function of viscosity, speed and ratio of diameter to clearance, divided by the pressure. Hersey[10], who considered all possible factors which might influence the friction, comes to a similar conclusion provided the supply of lubricant is adequate so that friction is independent of the rate of feed and the bearing is free from cavitation or end effects. Replacing Δ, the film thickness of a concentric journal, by 2Δ, the difference in diameter of bearing and journal, the term $\frac{\mu n}{p}\left(\frac{d}{2\Delta}\right)^2$ may be called Sommerfeld's criterion and will be represented by S.

Considering the factors of Sommerfeld's criterion separately, μ is the viscosity, preferably taken in poises, the c.g.s. unit of viscosity, since data on viscosity are usually given in this unit or in times of flow from which values in poises may be determined by suitable equations or diagrams.[11]

Wilson and Barnard[11] plot the coefficient of friction against zN/p, where "z is in centipoises relative to water at 68 deg. F., where it has a viscosity of 1 centipoise = 0.01 poise." As I have taken μ in poises, $z = 100\ \mu$. The viscosity of lubricating oils is high enough so that the poise is at least as convenient as the centipoise, and there is some objection to introducing the idea of relative viscosity since this is so often confused with relative times of flow.

With μ in poises, S will be dimensionless if the pressure, p, is expressed in dynes per square centimeter (1 lb. per sq.in. = 69,000 dynes per sq.cm.), the speed, n, is expressed in revolutions per second, and d and Δ are taken in any convenient unit.

For a given bearing of constant smoothness, the friction is a function of the viscosity if the pressure, speed and clearance are constant. If the viscosity and speed are both variable, the friction will be a function of μn as plotted by Biel.[12] If μ, n and p are all variables (and they are seldom absolutely constant in actual tests) and the clearance is constant, friction will be a function of $\frac{\mu n}{p}$ as shown by Hersey.[13] It seem preferable, however, to introduce the term $\left(\frac{d}{2\Delta}\right)^2$ and plot the coefficient of friction against S in order to emphasize the effect of the clearance upon the friction, and to prevent a heedless and unwarranted assumption that the clearance was constant when it was not.

According to Sommerfeld the lowest coefficient of friction, or value of f at the transition point, will be

$$f = \frac{2}{3}\sqrt{2}\left(\frac{2\Delta}{d}\right) \qquad (1)$$

This will occur when Sommerfeld's criterion has a constant value of

$$S = \frac{\mu n}{p}\left(\frac{d}{2\Delta}\right)^2 = \frac{5}{24\pi^2} = 0.0211 \qquad (2)$$

Hersey gives friction curves for ideal bearings, obtained by a graphical method, taking $\frac{2\Delta}{d}$ as 0.001, 0.002, 0.004 and 0.010, for which the values of f at the transition point are 0.00094, 0.00188, 0.00377 and 0.00943 respectively, and agree with equation (1). His values of $\frac{\mu n}{p}$ vary as to the square of the clearance, according to equation (2).

Wilson and Barnard concluded that the value of $\frac{\mu n}{p}$ at the point of minimum friction varied with the oiliness. If this can be confirmed, or preferably if it can be shown that the value of S at the point of minimum friction varies with the oiliness, journal friction machines might be used under certain conditions to measure oiliness.

In the great majority of recorded tests the clearance is unknown. Even in the few cases where the clearance was measured when the bearing was new, it is possible that the clearance changed by wear before the tests were completed. It is none the less desirable, on this account, to introduce the term $\left(\frac{d}{2\Delta}\right)^2$ as a reminder that any interpretation of the results of tests rests upon an assumption in regard to the clearance. When the clearance is unknown, it is convenient to assume that $\frac{2\Delta}{d}$ has the not unusual value of 0.001. Of course the true value should be used whenever known.

[8] W. H. Fulweiler and C. W. Jordan, *J. Ind. Eng. Chem.*, vol. 14, p. 723 (1922).

[9] A. Sommerfeld, *Zeit. für Math. und Physik*, vol. 50, p. 97, equation 46 (1904).

[10] M. D. Hersey, *Trans.* A.S.M.E., vol. 37, p. 182, equation 24 (1915).

[11] H. G. Nevitt, *Chem. & Met.*, vol. 22, p. 1171 (1920); N. MacCoull, "Lubrication," p. 5 (May, 1921); Winslow H. Herschel, *J. Soc. Automotive Eng.*, vol. 10, p. 87 (1922); R. E. Wilson and D. P. Barnard, 4th, *J. Soc. Automotive Eng.*, vol. 11, p. 49 (1922).

[12] C. Biel, *Zeit. d. v. d. Ingr.*, vol. 64, p. 449 (1920).

[13] *Loc. cit.*, Fig. 8.

A Study of Bearing Metals*

By Christopher H. Bierbaum
Vice-President Lumen Bearing Co., Buffalo, N. Y.

It is well established that bearing metals must be composed of an intimate mixture of soft and hard crystals, using the term hard to express the capacity for resisting cutting or abrasion. It is now being appreciated more and more that, for the most satisfactory bearing service, the physical properties of the journal bear some relation to the bearing metal, as for best service requirements the bearing and journal must polish each other. Therefore the hardest crystal in the bearing metal must bear some relation to the hardest crystal in the journal. The relative hardness of these individual crystals has not been studied heretofore, and it is with this object in view that the development of the herein described instrument was carried out and study begun.

THE first significant fact observed in the study of bearing metals is that not a single pure homogeneous metal has given satisfactory service; all bearing metals are alloys made up of two or more phases—that is, they consist of hard and relatively soft microscopic particles intimately mixed. The function of the hard particles, or *bearing crystals*, is to support the load and resist the wear when actual metallic contact exists between the bearing surfaces. The functions of the softer particles are to allow the harder particles to adjust themselves to the surface requirements of the journal and to wear down slightly below the surface of the harder, forming slight depressions on the apparently smooth wearing surface of the bearing, in which some of the lubricant is held when the bearing surfaces are brought into contact with each other. It is this characteristic of certain alloys to form these slight depressions, and thus provide the means for retaining a lubricant, that characterizes them as true bearing metals; in fact, a bearing metal has been defined as "an alloy that is capable of retaining a lubricant upon a bearing surface."[1] The extent to which the lubricant can be so held determines the most valuable characteristic of an alloy as a bearing metal.

An alloy that, perhaps, most characteristically represents a bearing metal is the composition of copper and tin that contains sufficient tin to produce the tin-copper eutectoid, or delta crystal. The depressions worn upon the surfaces of the softer crystals of the teeth of a motor-truck worm wheel, made of an 11 per cent tin bronze, in many cases were from 5 to 6 microns in depth; all other conditions remaining constant, this depth of wear increases with an increase of working pressure. This copper-tin bronze contains intercrystalline shrinkage cavities, which also tend to retain the lubricant, and the relatively low fusing temperature of the delta crystal permits the same, under severe treatment, to fuse upon the bearing surface, while it is being "run in." It is the dissimilarity of the component crystals, both in physical properties and in chemical composition, that makes bronze a bearing metal, and it is the similarity in physical properties and chemical composition of the component crystal that makes brass unsuited for this purpose.

Metals, as cast in the foundry for bearing purposes, are not in a state of equilibrium; they, therefore, must be studied in the condition in which they exist under service conditions. In fact, the value of controlling the chill effect on alloys, thereby rendering them especially serviceable for bearing purposes, is being appreciated more and more. In the copper-tin bronzes, where the delta crystal is desired, the chilling must be done with care; excessive chilling reduces the amount of this eutectoid formed, while cooling too slowly produces an undesirable coarse structure. Some other alloys cannot be chilled too suddenly, especially those in which it is important to reduce the grain size to a minimum. A bearing surface of bronze cast on a carbon chill, having grains of microscopic size, showed that, because the grains presented different angles of orientation, they wore at different rates, producing slight unevenness on the bearing surfaces, for which reason the grains, in a limited manner, caused a functioning of this bronze as a bearing metal.

So far all efforts to make accelerated wearing tests on bearing metals have failed because these tests are not made under service conditions, while tests made under service conditions are so prolonged that they lose their value. In almost all laboratory tests the softer, or more readily conforming, alloys are favored, as they are "run in" in a shorter time. The test of a readily conforming bearing metal upon the hardened-steel arbor of a testing machine is meaningless, when considering practical requirements; a bearing alloy should be tested against the same metal with which it is to be used in service.

The only physical tests on a bearing alloy, in the aggregate state, that can have any possible practical value are those for determining its physical properties and its safety factor for withstanding the treatment to which it is to be subjected under service conditions and temperature; all other conditions relating to bearing metals are of a microscopic nature and depend on the physical properties of the individual crystals constituting this metal.

If a journal could be fitted so as to be absolutely smooth, true and cylindrical, and additional polishing in service would be neither possible nor necessary, the journal could be made of a material having infinite hardness; but a journal of infinite hardness, not having a theoretically accurate surface, could not possibly give satisfactory wear with any bearing metal. In service, the bearing surfaces must polish each other; therefore, the hardest particles in one member must bear a definite relation to the particles in the other; to insure best results, they must be of the same order of hardness. For a long bearing life, there should be a polishing effect between the two metals rather than an abrading tendency.

When studying the abrasion or polishing effected in

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*A paper to be read before the February, 1923, meeting of the Institute of Metals Division.

[1]Report of sub-committee on bearing metals, A.S.M.E. (1919).

a new bearing, we find that the worn-off particles of metal, carried away by the oil, gradually decrease in size. In a new bearing, made of proper material and correct design, though poorly fitted up, the first particles worn off may be large enough to be seen with the naked eye; but as the operation continues the particles become microscopic and then ultra-microscopic in size. The largest abraded particles resemble ordinary filings, but as they decrease in size they become spherical in form. This statement is made with due consideration of the fact that for a proportionate decrease in size of particles, the resolving power of the microscope also decreases. In the coarser abrasions, we may find entire crystals, which may be considered as only incidental in reducing the bearing to proper working conditions. In the operation of a long-life bearing, giving satisfactory service, the wearing is of a microscopic or ultra-microscopic order and represents the abrasion of correspondingly small particles of one member upon those of the other.

From the foregoing, it seems obvious that a study of bearings, without taking into consideration both members, could not be conducive of practical results. It is

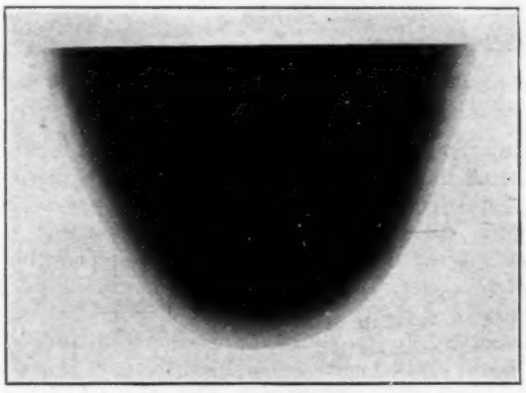


FIG. 1—SHADOWGRAPH SHOWING POINT OF FINEST CAMBRIC NEEDLE, SHARP'S NO. 12. × 2,000

also obvious that a knowledge of the physical properties, especially of the abrasion hardness of the different microscopic constituent elements of a bearing alloy, as well as those of the journal, is imperative.

A natural suggestion for testing on so small a scale was to reduce present methods to a corresponding degree of refinement; this at the outset proved impractical. In fact, all methods for testing any one crystal at a time failed, if for no other reason than its difficulty of application. A fact sometimes observed upon a metallographic specimen, polished on soft broadcloth, is that a continuous sharp cut, crossing several crystals, is wider on some than on others; this fact suggested the development of the instrument herein described.

The following fundamental requirements were established, after somewhat prolonged experimentation: (1) The cutting point must be ground with an extreme precision and to definite specifications; its shape must be such that the vertical pressure exerted upon the surface tested will be greater at all times than the horizontal pull applied to the point. (2) The cutting point must be so mounted that it can respond to required successive elevations with the least amount of inertia to overcome, and it must exert a constant pressure while passing over the test surface. (3) The cutting point must be moved

FIG. 2—PHOTOMIGROGRAPH OF SOFT-STEEL SURFACE SHOWING END OF MICROCUT. × 2,000

over the test surface at a uniform rate, slowly enough so that no additional indentation may occur by stopping on the softest crystal.

Various materials were experimented with when seeking a suitable cutting point: one that would be hard enough for all ordinary metals and their alloys, if possible including hardened tool steel; one having the necessary hardness and the microscopic homogeneity to permit it to be ground to an extremely accurate point. On account of its hardness, the diamond was the first material suggested, but its grinding has proved unsuccessful. Various other jewels have been tried, the sapphire, tourmaline, ruby, garnet, also various grades of special steels and tungsten. The artificial leuco sapphire (fused Al_2O_3) has proved extremely satisfactory, in that it has the necessary homogeneity, and is much harder than the crystals in the ordinary metals, including martensite in hardened steel and tin oxide (fused SnO_2). The latter is the hardest crystal so far encountered in any of the alloys or their impurities; its hardness is more than twice that of martensite.

The importance of a knowledge of the hardness of the individual crystals of the alloys was appreciated by the early investigators, when applying the microscope to the study of metals. Their investigations, however, were crude, in that they applied the points of steel needles in their work. The crudeness of any work done with a needle is evident from the shadowgraph, of 2,000 magnifications, of the point of the finest cambric needle, Sharp's No. 12, given in Fig. 1; in Fig. 2 is shown the end of a microcut made upon soft steel with a sapphire point ground to definite specifications. The point itself appears sharp under 2,000 magnifications.

After the selection of a suitable jewel, considerable difficulty was experienced in grinding a point that would be sharp and accurate to the extreme limits of the microscope. The grinding of a conical point was early abandoned as being impossible; the point that was finally ground successfully was the corner of a cube or a solid right angle. Fig. 3 gives the details of this point, (1) showing an end view and (2) a side view. The jewel was cylindrical in form 0.022 in. in diameter and 0.08 in. in length. It was cemented securely into a close-fitting hole in the end of the grinding stylus that made an angle of 54.73 deg. with the grinding disk. Three successive facets were ground upon the end of the jewel after successively rotating it through 120 deg., thus making the point the corner of a cube. The jewel point is mounted so that the diagonal of the cube shall be normal to the surface to be tested and with one edge advancing directly in line of motion. After grinding, the jewel was placed in a jig and, after all adjustments for accuracy had been made, cemented into the end of a flexible spring, while both

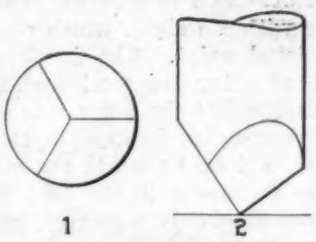


FIG. 3—DETAILS OF JEWEL POINT

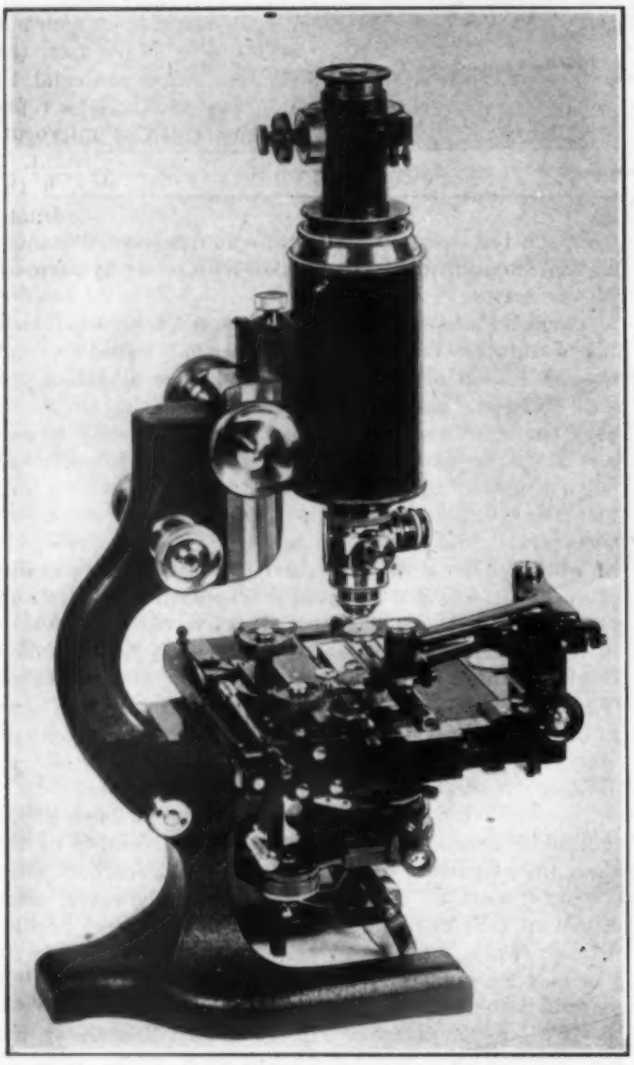


FIG. 4—MICROSCOPE COMPLETELY EQUIPPED WITH MICROCHARACTER AND MICROMETER EYEPIECE

the jewel and spring were held in the jig in the field of the microscope; the cement was a heavy solution of specially refined shellac. After the cement was thoroughly hardened, the excessive length of the jewel was ground off to reduce it to a minimum weight.

Fig. 4 shows a microscope complete and ready for work, equipped with the instrument developed for research on bearing metals; the name chosen for the instrument is Microcharacter. The instrument may be described as a mechanical stage with two additions, the jewel bracket at the right and the micrometer feed at the left. The jewel bracket, as shown in Fig. 5, is provided with a vertical rack for raising and lowering the bracket that carries the jewel suspension. This jewel suspension consists of a balanced arm, pivoted on sapphire bearings, one end of which is provided with a spirit level and the other with a weight, which constitutes the load for the jewel point. The jewel is mounted in the small end of a tapered steel spring, the other end of which is fastened to the lower side of the suspension arm. The suspension bracket is also provided with two adjusting devices, by which the microcut can be located so as to appear in the field of vision. These devices are not absolutely necessary, but are desirable, in that they make possible the testing of a crystal that may be selected in the field of the microscope. A worm and wormwheel attached to the longitudinal movement of the mechanical stage constitutes the micrometer feed.

The specimen to be studied should not be more than ¼ in. thick, and from 1 to 2 sq.in. in area; it should be placed upon an ordinary microscopic slide, leveled, and held in plasticine. After the specimen is in place, the jewel point is brought down upon it and the jewel suspension, by aid of the spirit level, is brought into a level position; this insures that the full load of the weight is being exerted upon the jewel point. The specimen is then moved along under the jewel point by

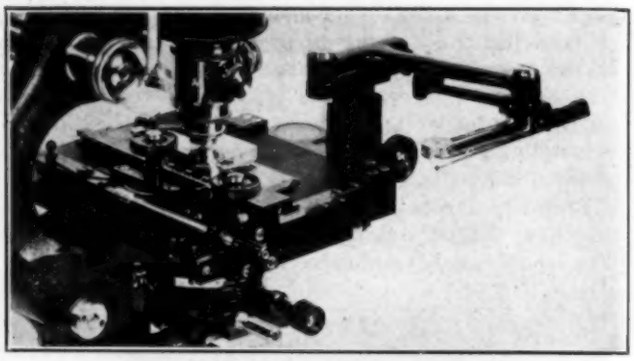


FIG. 5—MICROCHARACTER WITH JEWEL SUSPENSION BRACKET SWUNG OUT

the micrometer worm and wheel actuated by turning the small handle. A drop of oil should be placed upon the test surface and in contact with the jewel before starting, for a somewhat smoother microcut is then made. After the microcut has been made, the jewel bracket is elevated, by turning the knurled head, and swung out of position, as shown in Fig 5. The objective is brought into focus upon the microcut and, after it has been studied through a plain ocular, the micrometer eyepiece is substituted and the widths of the microcut are measured.

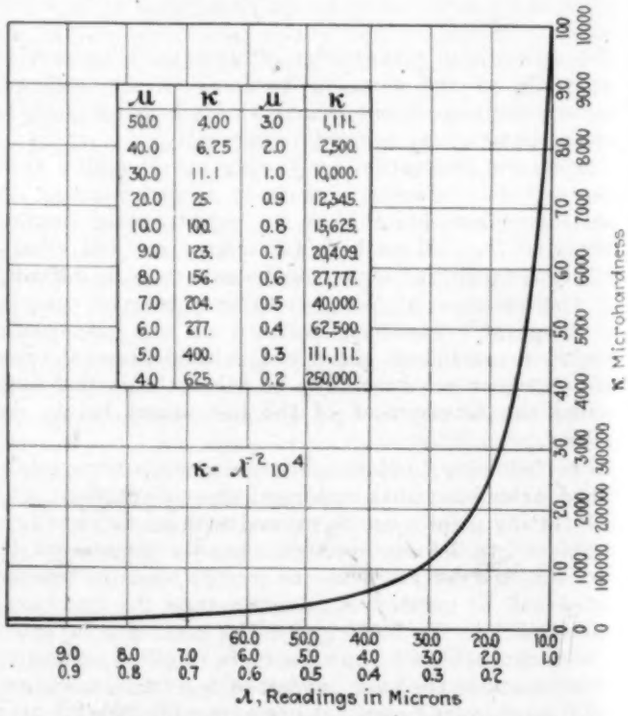


FIG. 6—FORMULA, TABLE AND DIAGRAM OF SCALE OF MICROHARDNESS

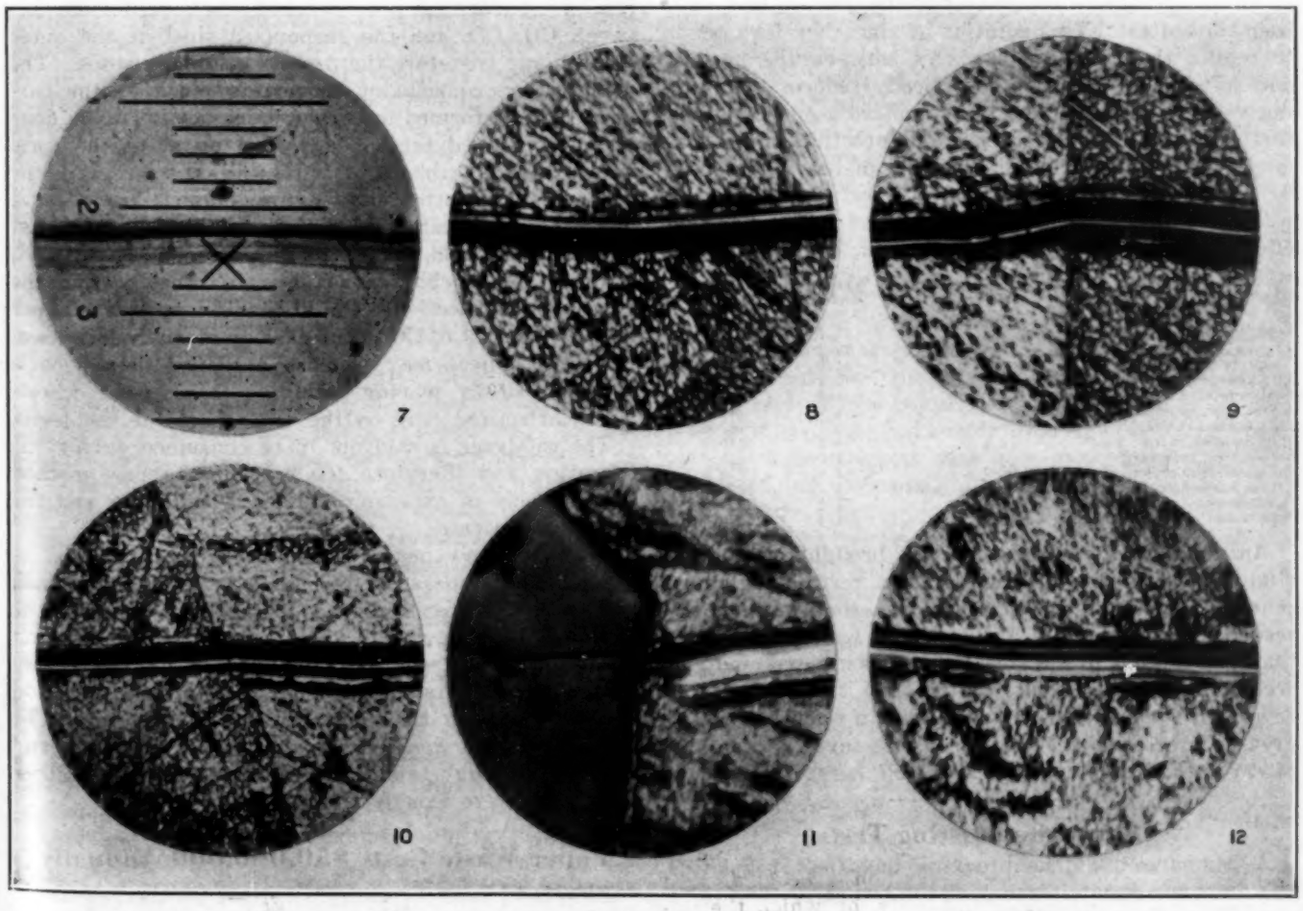
Fig. 7 shows a view of a microcut through the micrometer eyepiece; the focusing, of course, should always be done upon the original surface of the specimen. The X of the scale is moved to one edge, in which position a reading of the vernier is taken; after moving the X of the scale to the other edge the second reading is taken; both edges should be approached in the same direction. The difference between the vernier readings gives the fractional parts, whereas the full units can be read directly. It is necessary to calibrate the scale of the micrometer eyepiece by comparing it with the scale of a stage micrometer, for which the working set-up of the microscope should be used. The micrometer eyepiece scale is then calculated, in terms of microns, and the reading of the width of the microcut multiplied by this factor reduces the reading to terms of microns. A 2-mm. apochromatic objective with 160-mm. tube length and a 20× micrometer eyepiece with a 1-mm. scale gives substantially 2.5 microns per unit of scale division. A convenient weight upon the jewel point seems to be 3 grams, as with this load readings can be made upon the softest lead as well as upon the hardest steel without any change in the microscope set-up.

The micron, 0.001 mm., seems to be a convenient unit for our purpose. As the various cross-sections of microcuts in the different metals and alloys are symmetrical and their areas are proportional to the squares of their respective widths, these squares should be used for comparison. The same should appear as a factor in the mathematical expression for the value which may be designated as microhardness. For the reason that the greater widths represent the softer material the reciprocal of these squares should be used. Let κ represent the microhardness and λ the width of microcuts, then after multiplying by a convenient constant, to avoid unwieldy numbers, $\kappa = \lambda^{-2}10^4$. In Fig. 6 this formula has been plotted to two rectangular co-ordinates covering an ample range of microhardness.

The microhardness of grains in most metals varies in different directions; that is, if a grain on a polished metallographic specimen is cut in different directions the results vary within certain limits, and these limits vary for different metals. This property is illustrated by Figs. 8, 9 and 10. Fig. 8 shows a uniform width of microcut upon a surface of chemically pure copper. The two grains, of necessity, have a different angle of crystalline orientation but they presented approximately the same angle to the surface and the direction of the microcut, so the two crystals present an equal degree of microhardness. Fig. 9 shows the same two grains as in Fig. 8, but the direction of microcut is different, with the result that maximum and minimum microhardnesses are shown.

Fig. 10 shows the greatest difference of microhardness, so far encountered, for chemically pure metal; it shows a microcut of maximum and minimum widths for electrolytic zinc.

Fig. 11 shows a crystal of fused tin oxide imbedded in



FIGS. 7 TO 12

Fig. 7—Microcut through micrometer eyepiece.

Fig. 8—Microcut in two adjacent grains on pure copper having same apparent hardness. × 875.

Fig. 9—Microcut on same crystals as in Fig. 8 showing maximum and minimum microhardnesses of chemically pure copper. × 875.

Fig. 10—Microcut showing greatest range of microhardness of chemically pure zinc. × 875.

Fig. 11—Microcut upon fused tin oxide and bronze. × 875.

Fig. 12—Microcut upon slightly etched hardened tool steel. × 1,750.

bronze. The narrow width of microcut indicates the extreme hardness of the crystal which is found only in bronze that has been heated above the fusing temperature of tin oxide. It has long been known that "burned" bronze was destructive to bearings. The actual hardness of the crystal, however, does not seem to have been determined before this as being more than twice that of hardened tool steel; it is by far the hardest crystal found in any of the common alloys or their impurities.

Fig. 12 shows a microcut in hardened tool steel; the martensite formation is distinctly seen.

Heat tinting or very light etching may be used for the identification of crystals; the etching, however, should always be very light in order not to affect the results. This method of testing offers strictly comparable results, for a single microcut upon a substance of, say, unit microhardness would disturb as large a volume of material as 100 microcuts on a substance having a microhardness of 100. Should conditions require the hardness of the diamond, there is no doubt that it can be ground to this same degree of refinement and results obtained uniform with the present. While it is desirable that the instrument fit the microscope stage it is not absolutely necessary that it should; a plain stand may be improvised, and after the microcut is made the specimen can be transferred to the microscope, where all measurements can be made in the usual way.

By the use of this instrument, it has been clearly shown that the addition of zinc in excess of 2 per cent to a copper-tin bearing bronze increases the hardness of those crystals which, without the zinc, would have been the softest. This addition of zinc, therefore, tends to reduce the range of hardness between the hardest and softest crystals and theoretically reduces the bearing value of such an alloy. This offers a most striking corroboration between theory and practice, for it has long been known that the hardening of bearing bronzes by the addition of zinc increases the rate at which they wear off in service, and that this destructive wearing effect increases with an increase of zinc content.

Name of Substance	Width of Microcut, Average	Microhardness, Average
Lead, c.p., Picher	37.7	7.03
Tin, c.p., electrolytic	29.3	11.7
Copper, c.p., Raritan	11.8	78.4
Antimony, commercial	9.1	121.0
SnSb crystal as found in babbitt	6.9	208.0
Nickel, c.p., International Nickel Co.	6.4	244.0
PCu_3 crystal as found in phosphor bronze	6.1	267.0
Iron, Swedish, softest crystal	4.8	420.0
Cobalt, c.p., International Nickel Co.	4.0	625.0
$SnCu_8$, or delta crystal in copper-tin bronze	3.6	750.0
$SnCu_4$, hardest crystal in high-Cu hardened babbitt	3.2	1006.0
Hardened steel—Johansson test blocks	2.2	2229.0
SnO_2 (fused) as found in burned bronze	1.4	5390.0

An equally interesting fact was brought out in the study of the distinctive effect that a certain high percentage copper babbitt had on a low-carbon journal; the results showed that the $SnCu_4$ crystal was much harder than any crystal in the steel, which was unexpected and accounted for the result. While this instrument was developed for one patricular purpose, it should prove of greater interest, as it offers means for investigation and research that have not been available heretofore.

Dynamite Blasting Tests

A comparison of the breaking qualities of gelatine and ammonia dynamites under actual working conditions is to be made by the U. S. Bureau of Mines. During these tests a study of the fumes from blasting will also be made. An effort will be made to determine the amount of powder required with a standard round to break a foot of drift in different rocks.

A New Method for Case Hardening

By Frank Hodson
President Electric Furnace Construction Co.

A PROCESS which seems to have great possibilities for case hardening was recently shown to the writer by the well-known Swedish scientist, Dr. Assar Gronwall, who will be remembered as the inventor of the "Elektrometall" type of electric shaft ore-smelting furnace and various other electrical processes. Dr. Gronwall also showed a number of examples of this new case-hardening method, and I also had the privilege of examining records of tests made by Prof. Armd Johansson of the Tekniska Hogskolan, Stockholm.

Dr. Gronwall's process is based upon the fact that carbonizing is due to carbon monoxide, which in presence with iron at suitable temperature breaks up into carbonic acid and carbon, which latter, together with the iron, forms carbide of iron. In order to facilitate the process it is usual to mix with the carbonaceous packing a so-called carbonizing powder, such as carbonate of barium, metallic oxides, leather, bone, and even quartz and brick dust, which are supposed to facilitate the formation of CO within the furnace.

It is well known, however, that even using the best cementing mediums, the process is unnecessarily slow and that deep carbonization is very difficult. Dr. Gronwall's experiments proved that the gases inclosed in the case-hardening pots reached the equilibrium between CO, CO_2 and the carbonized steel at the outer surface and therefore the process gradually stops. The new method consists of converting much of the carbonic acid as formed to carbon monoxide. This is done by putting catalyzers of a special metal in the form of thin sheets, ribbons or wires into the box with the carbonaceous matter surrounding material to be case hardened. The catalyzer then acts in such a way that the carbonic acid, when coming in contact with it, changes into carbon monoxide. In other words, the catalyzer displaces the equilibrium in such a manner that the amount of CO in the gas is materially increased.

An iron object may be case hardened deeper on a certain spot by placing catalyzer there; gear wheels were carbonized only on the outer parts of the teeth.

The catalyzer is said not to be consumed during the operation and therefore the cost of the new method consists only of expense of original catalyzers and the license to operate.

With the new method less carbonizing material is needed, the temperature can be kept lower than usual, and time occupied is just about half. The tests at the Technical Academy, Stockholm, consisted in treating pieces of steel from the same bar in an electrically heated furnace, first in the usual case-hardening method and second with the addition of the catalyzer. The amount of case was considerably deeper in the second samples, although time occupied, temperature and other conditions were exactly the same.

Paper Waste Costs $50,000,000 Annually

Efforts to save the nation's forests by the reworking of waste paper was a feature of the past year's work of the American Paper and Pulp Association, which found that 300,000 acres of forest land could be saved by the collection of paper now being burned, which would be worth $50,000,000 a year to the paper mills.

A German Apologia

THE following appeared as an editorial in the *Chemical Age*, London, for Jan. 20, 1923, relative to German comment on a series of articles published by Mr. Negru on "European Conditions as I Saw Them":

"A few days ago an interesting package reached us from Berlin—so insufficiently stamped, it is our painful duty to add, that inspection of its contents could only be obtained by the payment of 8d. excess. On being opened, it was found to contain a pamphlet by Dr. W. A. Dyes, of Berlin, constituting 'an appeal to commonsense,' and a reply to a series of articles which Mr. J. S. Negru, a member of the editorial staff of *Chemical & Metallurgical Engineering*, recently contributed to that journal on German conditions as he saw them during a 6 months' tour of Europe.

"We happened to meet Mr. Negru in New York shortly after his return from Europe. He went there as the representative of one of the most reputable journals and one of the best publishing houses in the United States. His object was to see things as they are, and to tell the American public what he saw. He recounted to us some of the difficulties put in his way. In spite of them he collected a considerable body of facts and published them. It was not to his interest or to that of his journal to write mischievous fiction; the purpose of his visit was to obtain first-hand information, and if as a Belgian he wrote occasionally with some feeling it is only what might have been expected.

"But Dr. Dyes resents his description of German conditions, and seeks to discredit it. One might imagine, if we did not recall such judicial reports as those of Lord Bryce's commission, that Germany had hitherto enjoyed a spotless record, and was entitled to have its word accepted against all other witnesses. If Mr. Negru discovered another side, he is by no means alone, and we know no reason for supposing that he visited Germany for any other purpose than to discover and make known the truth.

Sample of the Strange Psychology of the Teutonic Mind

With the immense detail of this 27-page pamphlet we have not space to deal. It is mainly interesting as another sample of the strange psychology of the Teutonic mind. During the war we were privileged to see some confidential German documents containing instructions to their information agents in this and other countries. They were a revelation of German mental ingenuity. And we have something of the same quality here. Out of his well-stocked pigeon-holes Dr. Dyes seems able to produce every favorable reference to Germany uttered since the Flood, and with pathetic belief in their efficacy he employs them to display his country arrayed in white robes. It is the attitude of a highly sensitive man, wounded in his conscience by being thought ill of, and indignant at the slightest aspersion on his honor. To Dr. Dyes it really seems impossible to understand any feelings save those of respect and confidence toward his country.

"As representing those who have no desire to see Germany 'go under,' may we offer him a few words of friendly advice? Throughout the war every device which Germany adopted, whether to inspire terror or to elicit sympathy, almost invariably produced the opposite effect. And Dr. Dyes exhibits just the same lack of imagination now—an immense and most ingenious capacity for seeing things in detail and total blindness to broad moral values and effects.

How Germany Can Re-establish Herself

"If Germany wishes to re-establish herself among the nations, it will not be by meticulous reasoning of this sort. It will be by frankly disowning her recent past, admitting the injustice inflicted on others, and making good the damage. France won the respect of the world by the splendid spirit in which she discharged the crushing penalties Germany imposed on her. The profound respect which Great Britain commands in the United States today is due to the quiet and dignified way which we, the most heavily taxed nation of all, face our obligations. If Germany desires to regain the world's respect, it can be done in the same way, but not by weaving ingenious webs of excuses or reciting long rolls of synthetic virtues or affecting the unsuitable rôle of the innocent and injured party. A little sackcloth and ashes would be far more becoming as well as more convincing."

Some Problems Which Brazilian Manufacturers Must Solve

Lack of Fuel and Inadequate Transportation Facilities Are the Chief Handicaps, but Labor Is Plentiful and Efficient

By Warren E. Emley

FROM August to December, 1922, I was favored with the opportunity of visiting many industrial plants in Brazil and of making a survey of conditions. Many of the ways of doing things are so radically different from the methods in vogue in this country that a description of them would be at least interesting to North American manufacturers. Before going into detail about any particular industry, it might be well to cite a few facts which have a general bearing on every industry.

Probably the most prominent factor, which has modified all manufacturing processes, is the lack of fuel. There is some coal mined in the most southerly state, Rio Grande do Sul, but this is far away from the industrial center of the country, and besides it is of very poor quality, being extremely high in both sulphur and ash. Serious attempts have been made to use this coal, powdered, in locomotives, but it is not satisfactory unless mixed with a better grade of imported coal. English coal costs 140 milreis (about $17) a ton, delivered at a factory in São Paulo. Oil shale and oil made therefrom are to be found in every museum, but the most careful inquiries failed to bring to light any commercial source of this material. Wood has been, and still is, the main reliance for fuel, but is now getting scarce within economical hauling distance of the factories and railroads. An effort is being made toward reforestation. Groves of eucalyptus extending for miles along the railroads are not an uncommon sight.

The fuel situation is saved by the unlimited supply of hydro-electric power. This has been developed to the point that cheap electricity is available throughout the industrial districts of the country. This dependence upon electric power has brought about a condition which seems peculiar, but is quite logical: a single company

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frequently makes a number of products which bear no relation to one another. Having purchased and developed a waterpower site to supply the primary business of the company and having expanded that business to its present economical limit, there is still some power left over, so that an entirely different industry is started to use this excess power or to use some natural resource which was accidentally acquired with the site. Thus one company makes clay tile, lime and paper; another makes enameled iron utensils, locks and keys and nickel-plated ware. Obviously the name of such a company can give no indication of its activities, a fact which is apt to be confusing to a North American.

The development of water power usually involves the holding of large tracts of land. This is facilitated by the fact that there is no tax on unimproved real estate. However, other taxes are sufficiently plentiful to make up for this lack. There is an annual tax to do business —a sort of license. Each state levies an import or export tax, or both, on all materials crossing its borders. Everything is subject to a retail sales tax. Some of these taxes are levied in gold milreis. There is no such thing as a gold milreis, so the taxes must be paid in paper. Once a week the Bank of Brazil publishes a statement showing how many paper milreis make one of gold, which is, in effect, a weekly change in the tax-rate.

Transportation, Labor and Machinery in Brazil

Transportation is difficult. For local hauling, the two-wheeled cart drawn by oxen or mules is very much in evidence. The system of hard-surfaced highways is growing, but outside of the cities the automobile truck is unknown. Some of the railroads are owned by the federal government, others by private individuals, and apparently the gage is fixed by the whim of the owners. This necessitates transshipment of freight into different cars at nearly every junction point. Distances between cities are great, and small towns are very few in number. In vast areas of the country there are no railroads, transportation being effected only by mules. Even the capital, Rio de Janeiro, must rely almost wholly upon ocean steamers to communicate with such large northern cities as Bahia, Pernambuco and Manaos.

Labor is plentiful, low priced and of excellent quality. It is mostly south European stock mixed with Indian and negro. Their necessities of life are few and easily supplied, so that they can live well on a low wage. Artisans have the pride of workmanship so characteristic of Italians and Spaniards, so that they will not do a poor job, no matter what the boss may tell them.

Machinery is practically all imported, and is very expensive. It is not the first cost of a machine which matters so much. In a land of plentiful labor and power, the efficiency of a machine is hardly worth considering. It is the repair cost that counts. If the smallest part of the machine breaks, it may shut down the entire factory for months until a new part can be imported. This is the important factor deterring manufacturers from a more extended installation of machinery. Many machinery manufacturers maintain agencies and carry a stock of spare parts in Brazil. This is frequently the determining factor in the selection of a particular kind of machine.

Although I visited many different kinds of factories, my interest was centered chiefly on building materials, their manufacture aud use. I hope in succeeding articles to show some of the points of difference between Brazilian and North American methods.

Canadian Experiments With Nitrite Fertilizer

Some interesting experiments were made in Canada during the past year with soda nitrogen. This byproduct of the American Nitrogen Products Co. was first brought to the attention of the Canadian Government Division of Chemistry in February, 1921, when it was being offered on the Pacific coast markets as a nitrogenous fertilizer. The examination of a sample received from the manufacturers revealed the fact that of the total nitrogen present, approximately two-thirds existed in the form of sodium nitrite and one-third in the form of sodium nitrate.

The practical experience with soda nitrogen so far has been limited to the knowledge gained from the results of investigations carried on with oats in the greenhouse at the Central Experimental Farm at Ottawa, with oats and potatoes at the Experimental Farm at Agassiz, B. C., and with potatoes, corn, beans and peas at the Experimental Station at Sidney, B. C.

In the experiment with oats in the greenhouse, soda nitrogen and nitrate of soda, in quantities of each representing applications of 150 and 300 lb. per acre, were compared. In some series of plots the smaller and in another series the larger application was made at seeding time. In two further series the applications were made after the plants had attained 1-in. growth.

Of course, under greenhouse conditions the activities of the nitrifying bacteria would be favored, so that the conversion of the nitrite to nitrate would have taken place almost immediately. Be this as it may, observations made at the beginning and during the progress of the experiment failed to detect evidence of injury either to the germinating seedling or to the maturer plant at any stage.

The heavier applications, whether of soda nitrogen or of nitrate of soda, gave results superior to those from the lighter applications, while the untreated checks were decidedly inferior. The experience at Ottawa was repeated in a field test with oats at Agassiz, B. C.

The results of the experiment with potatoes at Agassiz favor nitrate of soda throughout. Besides the nitrogenous material, each fertilized plot received superphosphate and muriate of potash at the rate of 300 lb. and 150 lb. per acre respectively.

The experiments at Sidney, B. C., were carried out on a small scale with potatoes, corn, beans and peas. Of the corn, beans and peas on the plots receiving soda nitrogen, 90 per cent failed to germinate, whereas germination on the nitrate of soda plants was normal. On potatoes there was much less evidence of injury.

Engineering Tables for Low Pressure Air and Gas

Calculations involving the flow of air at low pressure are simplified through the use of data and charts contained in Bulletin 118, Engineering Tables, published by the P. H. & F. M. Roots Co., Connersville, Ind. The bulletin is designed to give as completely as possible the information which is required in making installations of blowers, pumps and exhausters for various services, such as agitation of liquids, pneumatic conveyors, foundry cupolas, combustion of fuel oil, water-gas sets, etc. General tables complete a booklet which chemical engineers will find very useful.

Fundamentals of Rectification

Effect on Rectification of Liquid Feed at an Intermediate Level

Also Conditions for Minimum Reflux and an Example of the Use of the Derived Formula Taken From Liquid Air Fractionation*

BY C. C. VAN NUYS
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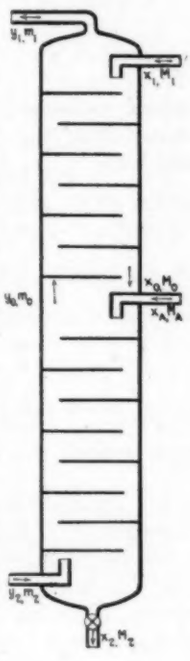
NOW let us consider the case where we have a liquid of composition x_A and mass M_A entering at an intermediate point of the rectification column.

In what follows, we shall assume that the composition of all fluids entering and leaving the column are given or stipulated. That is to say, x_A, x_1, y_1, x_2 and y_2 are to be considered as constants. Since the equations we shall write take no account of phase relations, we may, if we choose, suppose that x_1 and y_1, and also x_2 and y_2, are compositions of liquid and vapor in phase equilibrium. The only supposition we shall make at present regarding x_A is that its value lies between x_1 and x_2.



We then have six equations containing four M's and three m's, and by means of these equations we may determine the ratio between any two of the seven (M, m)'s.

These six equations are as follows in which m_0 is the mass of ascending vapor passing per unit time the level of admission of the liquid x_A and M_0 is the mass of liquid descending from above at this level.

$$M_1 + m_0 = M_0 + m_1$$
$$I_1M_1 + y_0m_0 = x_0M_0 + y_1m_1$$
$$J_1M_1 + J_0m_0 = I_0M_0 + J_1m_1$$
$$M_A + M_0 + m_2 = M_2 + m_0$$
$$x_AM_A + x_0M_0 + y_2m_2 = x_2M_2 + y_0m_0$$
$$I_AM_A + I_0M_0 + J_2m_2 = I_2m_2 + J_0m_0$$

Let us assume that M_A is fixed arbitrarily, then the values of M_1, M_2, M_0, m_1, m_2 and m_0 may be determined in terms of M_A and of the various x's, y's, I's and J's. This system of equations may be readily solved by properly changing subscripts in the results obtained from the system of three equations solved above. We thus obtain

$$M_0 = \frac{(J_1 - I_1)(y_0 - y_1) + (J_0 - J_1)(x_1 - y_1)}{(J_0 - I_0)(y_0 - y_1) + (J_0 - J_1)(x_0 - y_0)} M_1$$

$$m_0 = \frac{(J_1 - I_1)(x_0 - x_1) + (I_0 - I_1)(x_1 - y_1)}{(J_0 - I_0)(y_0 - y_1) + (J_0 - J_1)(x_0 - y_0)} M_1$$

$$m_0 = \frac{[(J_2 - I_2)(x_2 - x_A) + (I_2 - I_A)(x_2 - y_0)]M_A}{(J_2 - I_2)(y_2 - y_0) + (J_2 - J_0)(x_2 - y_2)} + \frac{(J_2 - I_2)(x_2 - x_0) + (I_2 - I_0) + (I_2 - I_0)(x_2 - y_2)M_2}{(J_2 - I_2)(y_2 - y_0) + (J_2 - J_0)(x_2 - y_2)}$$

whence

$$\{[(J_2 - I_2)(x_2 - x_A) - (I_2 - I_A)(x_2 - y_2)]$$
$$[(J_0 - I_0)(y_0 - y_1) - (J_0 - J_1)(x_0 - y_0)]\} M_A =$$
$$\{[(J_2 - I_2)(y_2 - y_0) + (J_2 - J_0)(x_2 - y_2)]$$
$$[(J_1 - I_1)(x_0 - x_1) + (I_0 - I_1)(x_1 - y_1)]$$
$$- [(J_2 - I_2)(x_2 - x_0) + (I_2 - I_0)(x_2 - y_2)]$$
$$[(J_1 - I_1)(y_0 - y_1) + (J_0 - J_1)(x_1 - y_1)]\} M_1$$

This value of M_A vanishes if

$$\frac{(J_1 - I_1)(x_0 - x_1) + (I_0 - I_1)(x_1 - y_1)}{(J_1 - I_1)(y_0 - y_1) + (J_0 - J_1)(x_1 - y_1)} = \frac{(J_2 - I_2)(x_2 - x_0) + (I_2 - I_0)(x_2 - y_2)}{(J_2 - I_2)(y_2 - y_0) + (J_2 - J_0)(x_2 - y_2)}$$

which is the same equation as that obtained above as the necessary relation between x and y in order for perfect rectification to be possible—that is to say, the amount of liquid of composition x_A that it is possible to add at the intermediate point is zero if the composition y_0 of the vapor having phase equilibrium with a liquid of composition x_0 bears the relation to x_0 as determined by the last equation written.

Now assume that we are dealing with a binary system which has the property described above—viz., the total heat J of the mixture at the dew point and also the total heat I at the boiling point follow the proportionality relation indicated by the equations

$$J = J_Bx + J_A(1 - x)$$
$$I = I_Bx + I_A(1 - x)$$

so that the latent heat L at constant pressure of any mixture of composition x is given by

$$L = L_Bx + L_A(1 - x)$$

For such a mixture the above relation between M_A and M_1 may be easily shown to take the form:

$$\frac{L_Bx_0 + L_A(L - x_0)}{L_Bx_1 + L_A(1 - x_1)} \quad \frac{M_A}{M_1} = \frac{(x_0 - x_1)(y_0 - y_0)}{(x_2 - x_A)(y_0 - y_1)}$$

$$\frac{L_By_1 + L_A(1 - y_1)}{L_By_2 + L_A(1 - y_2)} \quad \frac{L_Bx_2 + L_A(1 - x_2)}{L_Bx_1 + L_A(1 - x_1)} - \frac{x_2 - x_0}{x_2 - x_A}$$

Let us denote by l_1 the function $L_By_1 + L_A(1 - y_1)$ and by L_1 the same function of x_1 with a corresponding notation for y_0, y_2 and x_0, x_2. Then the last equation may be written:

$$\frac{L_0M_A}{L_1M_1} = \frac{M_A}{M_0} = \frac{l_1L_2}{l_2L_1} \quad \frac{(x_0 - x_1)(y_2 - y_0)}{(x_2 - x_A)(y_0 - y_1)} - \frac{x_2 - x_0}{x_2 - x_A}$$

In what follows we shall employ the term "equivalent mass," in speaking of the products L_1M_1, l_1m_1, etc. For example, the equation $L_1M_1 = L_2M_2$ obtained above for a simple column may be regarded as a statement that the equivalent masses of the liquid at the top and at the bottom of a simple adiabatic column are equal.

CONDITIONS FOR MINIMUM "REFLUX"

From the above equation for the mass ratio, $Z = \frac{M_A}{M_0}$, it follows that for fixed values of x_A, x_1, x_2, y_1, y_2 the maximum value of the ratio is obtained when y_0

*The first two articles in this series were published in the issues of Jan. 31 and Feb. 7, 1923.

is the least possible. If now, x_A is less than x_2, it is clear that the minimum possible value for y_0 is the composition of a vapor having phase equilibrium with the liquid of composition x_0, since this liquid has previously been in contact with a vapor whose composition is less than y_0. If, on the other hand, x_A is greater than x_0, then the minimum possible value of y_0 is that of a vapor having phase equilibrium with the liquids M_A and M_0 combined. That is to say, if x_2 is the composition of those liquids combined, the minimum possible value of y_0 is that of a vapor in phase equilibrium with a liquid of composition x_2.

We shall now ascertain the conditions existing in an adiabatic rectification column when, for a given mass, M_1 of "reflux" liquid entering the top, the maximum possible mass M_A of a given composition x_A is entering an intermediate point of that column, the end compositions x_1, y_1, x_2, y_2 being specified. Let us first suppose that the mass M_A is added at a point in the column and in amount such that after it has been flowing steadily the composition x_0 at this level of the liquid descending from above is the same as the composition x_A of that liquid—i.e., $x_A = x_0$. Under these conditions, let us determine for what composition $x_A = x_0$ the ratio $Z = \frac{M_A}{M_0}$ is a maximum if such a maximum exists. If we place $x_A = x_0$, our original expression for that ratio becomes:

$$Z = \frac{M_A}{M_0}\frac{l_1L_2}{l_2L_1}\frac{(x_0 - x_1)(y_2 - y_0)}{(x_2 - x_0)(y_0 - y_1)} - 1$$

That x_0 which makes the ratio Z a maximum must satisfy the equation $\frac{dZ}{dx_0} = 0$. From the equation for Z we obtain by differentiation:

$$\frac{dZ}{dx_0} = \frac{l_1L_2}{l_2L_1}\frac{(y_2 - y_0)(y_0 - y_1)(x_2 - x_1) - (x_2 - x_0)(x_0 - x_1)(y_2 - y_1)\frac{dy_0}{dx_0}}{(x_2 - x_0)(x_0 - x_1)(y_2 - y_1)}$$

If, however, the ratio Z is a constant whatever be the value of x_0, then $\frac{dZ}{dx_0}$ must be identically 0. That is to say, the equation

$$\frac{dy_0}{dx_0} = \frac{(y_2 - y_0)(y_0 - y_1)(x_2 - x_1)}{(y_2 - y_1)(x_0 - x_1)(x_2 - x_0)}$$

with given end compositions x_2, y_2, x_1, y_1, must be an identity—i.e., it must be satisfied for all possible pairs of values of x_0 and y_0 connected by the relation $y = F(x)$ where F denotes the functional relation between x and y for phase equilibrium.

If we assume that x_2 and y_2 and also x_1 and y_1 are any two given pairs of compositions of liquid and vapor in phase equilibrium, the most general form of the functional relation between x and y in order for the last equation to hold for all possible pairs of values of x and y may be derived as follows: The equation for $\frac{dy_0}{dx_0}$ may in that case be regarded as a differential equation in which the variables are x_0 and y_0. It may be written in the form:

$$\frac{dy_0}{y_2 - y_0} + \frac{dy_0}{y_0 - y_1} = \frac{dy_0}{x_2 - x_0} + \frac{dy_0}{x_0 - x_1}$$

Integrating this, we obtain:

$$\log_e(y_0 - y_1) - \log_e(y_2 - y_0) = \log_e(x_0 - x_1) = \log_e(x_2 - x) + \log_e$$

or

$$\frac{y_0 - y_2}{y_2 - y_1} = K\frac{x_0 - x_1}{x_2 - x_0}$$

where K is a constant for any (x_0, y_0) with given values of (x_1, y_1) and (x_2, y_2).

Since K in the last equation is a constant for any (x_0, y_0), it must be the same when $x_0 = y_0 = 0$ as when $x_0 = y_0 = 1$. In the first case, we have:

$$\frac{y_1}{x_1} = K\frac{y_2}{x_2}$$

and in the second case, we have

$$\frac{1 - y_1}{1 - x_1} = K\frac{y_2 - 1}{x_2 - 1}$$

or, by division:

$$\frac{\frac{y_1}{1 - y_1}}{\frac{x_1}{1 - x_1}} = \frac{\frac{y_2}{1 - y_2}}{\frac{x_2}{1 - x_2}}$$

Since, however, (x_1, y_1) and (x_2, y_2) are any pair of values satisfying the functional relation desired, we must have

$$\frac{\frac{y_0}{1 - y_0}}{\frac{x_0}{1 - x_0}} = a$$

where a is a constant for any (x_0, y_0) whatever—i.e.,

$$\frac{y_0}{1 - y_0} = a\frac{x_0}{1 - x_0}$$

is the most general form of the functional relation which makes the above equation for $\frac{dy_0}{dx_0}$ an identity.

This equation between co-existing liquid-vapor phase compositions is characteristic of those mixtures which in the liquid state have the properties of dilute solutions for which the heat of mixture is zero. (See Kuenen, "Theorie Der Verdampfung und Verflussigung von Gemischen," pages 127, 144-145.) This relation is satisfied approximately by a considerable number of two-phase binary liquid mixtures of the type having no maximum or minimum vapor pressure composition. In particular, it is satisfied approximately by liquid mixtures of oxygen and nitrogen, as we shall see later.

The above result shows that for a mixture satisfying this relation, the quantity of "reflux liquid," M_1 of a given composition necessary for a constant equivalent amount of the liquid M_A is constant—i.e., does not depend on the composition x_A of that liquid. We assumed in the above discussion that the composition x_A was identical with the composition x_0 of the liquid descending in the column at the point where the liquid M_A was added.

That, for given compositions x_1, y_1, x_2, y_2 of end products and for a given amount of "reflux" M_1, the amount, M_A, of liquid of a given composition x_A that it is possible to add at an intermediate level in the column is a maximum for this type of mixture when the condition $x_A = x_0$ is satisfied, may be shown as follows:

First assume that conditions are such that $x_0 > x_A$. Then the value of the ratio

$$\frac{M_A}{M} = \frac{l_1L_2}{l_1L_2}\frac{(x_0 - x_1)(y_2 - y_0)}{(x_2 - x_A)(y_0 - y_1)} - \frac{x_2 - x_A}{x_2 - x_0}$$

for given values of x_A and x_0 is the greatest possible

when the relation between x_0 and y_0 is that for phase equilibrium. With this value of y_0 the above expression for the ratio $\frac{M_A}{M_0}$ is a maximum when x_A is as large as possible. That is, x_0 and y_0 being fixed, that ratio is greater when $x_A = x_0$ than when $x_A < x_0$. But since when $x_A = x_0$ the value of that ratio is independent of x_0, it follows that, x_A being fixed, the ratio is greater when $x_0 = x_A$ than when $x_0 > x_A$.

Next assume that $x_0 < x_A$. Then the least possible value of y_0 is that for phase equilibrium with the combined liquids M_0 and M_A. If x_2 is the composition of this combined liquid, we have

$$x_2(M_0 + M_A) = x_0 M_0 + x_A M_A$$

from which

$$x_A = (x_2 - x_0)\frac{M_0}{M_A} + x_2$$

Substituting this value of x_A in the equation

$$\frac{M_A}{M_0} = \frac{l_2 L_2 (x_0 - x_1)(y_2 - y_0)}{l_2 L_1 (x_2 - x_A)(y_0 - y_1)} - \frac{x_2 - x_0}{x_2 - x_A}$$

we obtain

$$\frac{M_A}{M} = \frac{l_1 L_2 (x_0 - x_1)(y_2 - y_0)}{l_2 L_1 (x_2 - x_1)(y_0 - y_1)} - 1$$

Now suppose that x_2 remains constant—i.e., x_A decreases and x_A increases in such a way as to maintain x_2 constant; then y_0 remains constant. But as x_0 increases, the ratio $\frac{M_A}{M_0}$ increases—i.e., the ratio when $x_2 = x_A = x_0$ is greater than when $x_0 < x_2 < x_A$. Since, however, when $x_2 = x_A = x_0$, the ratio is constant whatever be the value of x_0, it follows that for a constant x_A a maximum value of the ratio $\frac{M_A}{M_0}$ is obtained when $x_0 = x_A$.

In other words, for minimum reflux the liquid feed entering an intermediate level should be admitted in amount and at a level such that the composition of the liquid descending in the column has the same composition at that level as the entering liquid.

Example of Use of Preceding Formulas

As an example, let us consider the case where we are rectifying a liquid whose molecular composition is 40 per cent oxygen. Then $x_0 = 0.40$. The molecular composition of the vapor having phase equilibrium with the liquid is, according to Baly, 15.5 per cent; i.e.:

$$y_0 = 0.155$$

Let us assume that we obtain pure liquid oxygen at the bottom and pure nitrogen vapor at the top of the column. On this assumption, we have:

$$x_2 = y_2 = 1 \quad x_1 = y_1 = 0$$

For oxygen, $L_B = 51.15$ cal. per gram, or 0.0731 cal. per c.c., and for nitrogen, $L_A = 47.85$ cal. per gram, or 0.0598 cal. per cc.

Substituting these values in the above equation between M_A and M_1, we obtain:

$$M_A = 2.42 M_1$$

or

$$M_1 = 0.413 M_A$$

as the minimum relative amount of "reflux" liquid necessary. If the 40 per cent liquid is obtained by selective liquefaction of a gaseous mixture of nitrogen and oxygen, the percentages of which have the same ratio as those of ordinary air, the increase of the oxygen percentage of the liquid being obtained by withdrawing a residual gas composed of pure nitrogen during the process of liquefaction, then the amount of this pure nitrogen vapor available after liquefaction for use as "reflux" liquid may be calculated as follows:

Dry air contains, by volume, 21 per cent oxygen and 78 per cent nitrogen approximately, the remainder being mostly argon, carbon dioxide and hydrogen—i.e., the relative molecular percentages of oxygen and nitrogen in air are, say, 21 per cent oxygen and 79 per cent nitrogen.

Since the oxygen contained in the 40 per cent liquid is 21 per cent of the original gaseous mixture, all of this liquid is $21 \div 40 = 52\frac{1}{2}$ per cent of the whole. Hence the pure nitrogen withdrawn during the formation of the liquid enriched in oxygen is $100 - 51\frac{1}{2} = 47\frac{1}{2}$ per cent of the whole.

The minimum amount of nitrogen necessary as reflux liquid, being 0.413 times as much as the liquid enriched in oxygen, will be $0.413 \times 0.52\frac{1}{2} = 0.217$ of the whole. Hence there will be as surplus a maximum of $0.475 - 0.217 = 25.8$ per cent of the whole as pure nitrogen not necessary for perfect rectification.

Continuation of this series of articles will be published in a subsequent issue.

Surface Oxidation During Hardening

One of the problems now being studied by the gage steel committee of the Bureau of Standards is the dimensional changes on hardening. To determine this, an accurate 4-in. cylinder 1 in. in diameter is measured and weighed both before and after hardening.

Surface oxidation may easily cause a scale to form thicker than the changes expected. If the scale is removed, some metal is lost and the change recorded is less than that due to hardening alone. The dimensional changes on hardening may be completely masked by the scaling effect. Coatings such as enamels, sodium silicate and electrodeposited silver have been tried in an effort to prevent oxidation in the air atmosphere of an electric furnace, but none was satisfactory under these conditions. However, by allowing illuminating gas to flow into the furnace at a rate just sufficient to burn the air leaking in, oxidation was apparently inhibited without disagreeable fumes from the furnace. Scale is then formed only during transfer to the quenching bath and is removed by cleaning with gasoline and pickling for a short time in cold 10 per cent H_2SO_4.

It was recently noticed that the 4-in. gage specimens, weighing about 400 grams, were losing from 0.5 to 1.0 gram in weight on hardening in this manner. To determine at what stage the loss occurred, a specimen was heated to 800 deg. C. as above, and after holding in the air for 5 seconds, was quenched in a small can of water so that the scale could be recovered. The weight of scale collected was 0.81 gram and the loss of weight of the specimen was 0.56 gram. On pickling 10 minutes, the specimen lost 0.19 gram more, and on repeating the pickling only 0.01 gram, showing that the acid removes residual scale not flaked off during the quenching, but does not attack the metal seriously. This specimen increased in length by 0.0144 in. and in diameter by 0.0004 in. on hardening, but before pickling. On pickling it lost 0.0004 in. in both length and diameter, which is evidently the thickness of the remaining oxide.

The total loss of 0.76 gram is equivalent to a layer of metal about 0.0004 in. thick over the whole surface, or a loss of double that amount in length and diameter.

Legal Notes

By Wellington Gustin
Of the Chicago Bar

Officers as Dual Agents

Presumption Against Validity of Transactions by Men Acting for Both Corporations

In a suit brought by the Mathieson Alkali Works against Arnold Hoffman & Co., Inc., the U. S. District Court in its opinion (280 Federal, 133) says that there is a strong presumption against the validity of transactions between corporations where conducted entirely through the agency of officers acting at the same time for both corporations, and the burden is on those who would maintain the transactions to show their entire fairness.

And a settlement or acceptance of accounts rendered requires independent representation to the party to whom they are rendered, and there can be no account rendered as between corporations where the transactions are conducted entirely through the agency of officers acting at the same time for both.

Again the court says that in a controversy between two corporations, when plaintiff corporation sought an accounting from defendant corporation, which was both a buyer and an agent for sale, with a limited agency, as in this case, the plaintiff is presumed to know what disposition was made of its own product and what it received for it from defendant, both as buyer and as sales agent. It is the duty of plaintiff, its officers and directors, to conduct its business with ordinary care, and the burden of explanation rests on it which cannot be sustained by a mere general claim that it confided implicitly in the defendant, so as to require the defendant to assume the burden.

Further, it says that when a business transaction is closed by an agent and his report is made thereon, the principal is charged with knowledge of what is reported, and cannot excuse himself from responsibility for action or inaction by continued reliance on one who is no longer a fiduciary as to completed transactions.

Langmuir Patent Again Upheld

Preliminary Injunction Granted Against Company Copying Tungsten-Nitrogen Lamps

Application of the General Electric Co. for a preliminary injunction against the Incandescent Products, Inc., was recently granted on the basis of the Irving Langmuir patent No. 1,180,159, owned by the former. This patent has been upheld in many cases and in various jurisdictions, and the court says ordinarily a patentee presenting such facts is entitled to a preliminary injunction on a showing of infringement. (280 Federal Rep. 856.)

The courts have written the history of the incandescent electric light lamps prior to the Langmuir invention. The Edison elements were three—a carbon filament, in a vacuum, inclosed in a glass chamber. These elements remained the same, with refinements, until Langmuir introduced into the art a co-ordination between a coiled tungsten filament in nitrogen, argon or mercury vapor gas, inclosed in a glass chamber under pressure.

The court says defendant's lamps are designed for use in the ordinary circuits. Those manufactured directly are rated at 150, 100 and 75 watts. The imported Austrian lamps sold by it are rated at 40 and 25 watts. There is in each a glass container with a coiled tungsten filament, filled with nitrogen gas under pressure. In the Austrian lamp the gas is a mixture of argon and nitrogen.

Defendant's Action Willful Disregard of Established Rights

There is nothing to distinguish defendant's lamps from the plaintiff's, as the entrance of the defendant into such business, after the establishment of the validity of the plaintiff's patent in another jurisdiction, indicates not only a slavish imitation but a willful disregard of established rights, says the court.

Defendant contended that the Langmuir patent is limited by the measure of the effectiveness and life of the lamps, as contrasted with those in which a vacuum was used. But the court points out that the patent was granted on a structure definitely described and clearly portrayed, the privilege being for the structure and not the result. It says it was a device, and not a result, which was patented, and the defendant can avail itself of nothing because in its manufacture the parts used by the Langmuir are so inartistically correlated as to produce a less efficient result.

Again, defendant called attention to the prior French patent La Tang No. 384,915 as an anticipation, and also to the Edison patent. But the court says the Langmuir patent having a tungsten filament in nitrogen gas was not infringed by prior patents for a vacuum tungsten lamp, or for a lamp having a carbon filament in nitrogen gas.

Sale of Element of Patented Combination Does Not Give Implicit License to Use Combination

More litigation involving the infringement of the Langmuir patent No. 1,180,159 is found in two separate suits in equity brought by the General Electric Co., against the Continental Lamp Works, Inc., and against the United Lamp Manufacturers' Corporation. (280 Federal 846.) Defendants admitted the validity of the patents, but denied infringement, claiming an implied license.

It appears that the General Electric Co., plaintiff, sold and continued to sell lamp bases for the lamp of the Langmuir patent to defendants after it knew or had reason to believe that the latter were using these bases in the manufacture of lamps infringing the Langmuir patent. Plaintiff contended that in making such sales it was not granting a license under the lamp patents, the contract of sale providing in red letters:

"The sale of bases by us confers on the purchaser no license under any patents of the General Electric Co. covering or relating to the structure of incandescent lamps, or the materials, machines or processes used in their manufacture."

Trial Court Held Plaintiff's Knowledge Implied License

Regardless of this, the defense contended that by reason of the purchase of the bases there was an implied license to use the lamps constructed under the Langmuir patent. The trial court upheld this contention and gave

judgment for the defendants, upon the theory that the bases which the plaintiff sold to them were sold with the knowledge that these manufacturers were making the lamps under an implied license from the plaintiff, General Electric Co., and that because the bases which were sold could be used only in constructing a patented article (Langmuir construction), it is presumed in law to be intended, by both the buyer and seller, to be used for that specific purpose, and when the plaintiff made a sale it carried with it to the defendants an implied license.

This decision was reversed by the United States Circuit Court of Appeals. It said the burden was upon the defendants to establish that the parties agreed, by a meeting of the minds, that the license contended for should be granted, or that when the bases were purchased the parties understood, and the defendants had adequate reason to assume, that they had received an implied license under the circumstances, which stopped the owners of the patent from denying that such was the intention of the parties at the time of the sales. And the court found the facts to be that there was nothing written or spoken from which a license was granted or might be implied.

Inventor Controls Terms for Use of Invention

Use of an invention can be obtained only on the inventor's terms. Without paying or doing whatever he exacts, no one can be exempt from his right to be excluded and, whatever the terms, the courts will enforce them, provided, of course, the licensee is not thereby required to violate some law outside of the patent law. On this point, in the case of United Nickel Co. vs. California Works, 25 Federal 475, the court said:

"The selling of the solution does not authorize, inferentially or otherwise, the use of it for the purpose of nickel-plating, whatever else it may be used for, without also procuring a license to nickel-plate under the first and fourth claims, which are separate inventions."

So where the owner of a patent sells a patented article subject to a restriction, the purchasers, with notice of this limitation, could acquire no better rights than strangers to infringe upon that part or claim of the monopoly still secured to the patentee. And the sale of an element of a patented combination does not necessarily imply license to use the whole combination. But there is always a question of what is a fair inference from the transaction.

In Edison Electric Co. vs. Peninsular Light Co., 43 C. C. A. 479, Judge Lurton pointed out that there may be circumstances under which the sale of a patented article by the patentee will carry with it the right to use another in co-operation with the first, although the thing be covered by a second patent, such as where an article of a peculiar construction is sold which has no practical use unless it be used in combination with some subordinate part covered by the patent of the vendor and the right to use the latter in co-operation with the former might be implied under the circumstances.

Rule of Law Covering Such Cases

The law was stated by Judge Lurton in these words: "The limitation upon this is that the things which pass by implication only must be incidental to the grant, and directly necessary to the enjoyment of the thing granted; the foundation of the maxim lies in the presumption that the grantor intended to make his grant enjoyable. . . . It is evident that the extent of an implied license must depend upon the peculiar facts of each case. The question in each case is whether or not the circumstances are such as to estop the vendor from asserting infringement."

In the case at bar this rule was applied. The court said that the mere sale imparts no license, except where the circumstances plainly indicate that it did, or except where good faith required, or where it cannot be doubted that the vendees understood that they were getting a license. In view of the red-lettered provision in the terms of sale, there was no justification for the vendees' assumption that they received a license under the patent. Neither conduct or language of the parties would justify the buyers of the bases in their use of the patented lamp in connection with same. The bases were capable of non-infringing uses, and the notice on its face was intended to warn against the use by infringement of the patent in suit. Therefore the lower court's judgment was reversed.

Breach of Implied Warranty

Federal Court of Appeals Holds Payment of Price Does Not Bar Action for the Breach

A question in sales law was presented in an action brought by the Lackawanna Steel Co. against the Herbrand Co. in the federal District Court, whose judgment was partly affirmed by the U. S. Circuit Court of Appeals. (280 Federal Rep., 12.)

Suit was brought for the price of a large quantity of steel bars sold to defendant, which counterclaimed for damages alleged for an asserted breach of implied warranty of fitness of a large amount of steel bars purchased in the previous year. The damages claimed consisted of the difference between the invoice value of the defective steel and its scrap value ($4,605.15), together with expenses incurred by plaintiff ($16,927.50) in manufacturing the defective forgings.

Plaintiff denied the claims of defendant. First, because defendant paid in full for the steel after it knew or should have known of the alleged defects therein. Second, because there was a general custom existing in the steel trade at the time whereby the manufacturer was not liable for the cost of labor or other expense incurred by the buyer in working defective steel, but that the latter's remedy with respect to reimbursement was limited to the replacement of the steel.

A verdict was directed upon the sole ground that defendant's right to complain of the defective steel was barred by its voluntary payment of the purchase price in full, with knowledge of the defects. It is a general rule of law that money voluntarily paid with full knowledge of the facts cannot be recovered.

Question of Waiver of Warranty Is a Question of Fact

But the Court of Appeals points out that an action for breach of warranty is not barred as a matter of law by payment of price. A retention of goods purchased and the payment of the price, or suffering the seller to recover a judgment therefore without defense and with knowledge of breach of warranty, does not as matter of law bar an action for the breach. The question of waiver of the warranty is at the most one of fact. Nor does retention of goods and payment bar an action for breach of warranty under the uniform sales act

as in force in Ohio. And while the extension of time granted for payment would furnish a good consideration for the waiver of action for breach of warranty, an extension does not as matter of law show such a waiver under the uniform sales act.

Now whether the defendant waived its right to damages under the circumstances of having paid without protest, etc., was a question of fact that should be left to a jury to decide.

Custom Limiting Liability Held Not Unreasonable

The custom in the steel trade as alluded to was established by witnesses, and this custom, under which the buyer's only remedy for defective steel was replacement or credit for its value, at the buyer's option, the seller not being liable for cost of labor or other consequential damage, the court held was not an unreasonable custom.

But the court said this custom did not forbid a recovery for failure to replace defective and unused steel, whose purchase price was greatly in excess of its scrap value; the seller being asked to replace such defective steel and having failed to make such replacement.

For error of the District Court in directing verdict for plaintiff in full of its claim the judgment was ordered reversed unless the plaintiff should remit from the judgment the sum of $4,605.15, covering the defective steel.

New Quenching Tank

Fig. 1 shows a quenching device recently designed by the W. S. Rockwell Co. The rectangular tank is filled to any desired depth with circulating oil or water. Heated metal parts of such size and shape as will permit

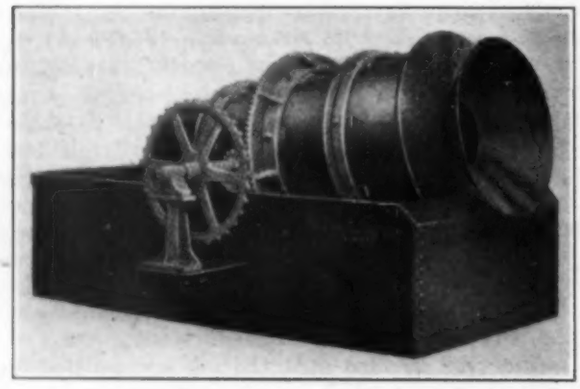


FIG. 1—ROCKWELL ROTARY QUENCHING TANK

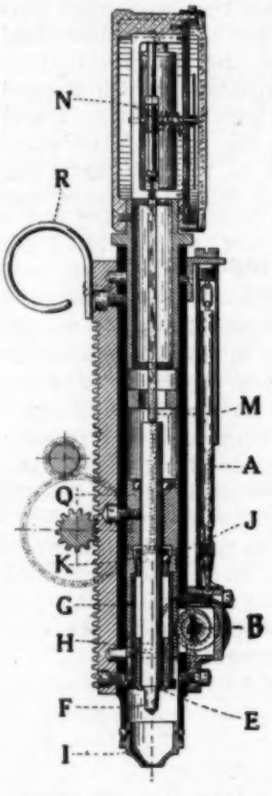
tumbling about are then dropped into the submerged end of the rotating drum. It is then automatically picked up in small batches by the internal thread of the rotating tank and conveyed through the quenching fluid as it is raised to the cone-shaped discharge spout. Naturally the device works best with a continuous flow of heated metal.

New Model Scleroscope

The problem of recording indications of the well-known Shore Rebound Reading Scleroscope Model C was solved by the use of a comparatively long hammer *F*, which, being much heavier, develops the same striking force by dropping only a short distance (¾ in.). This principle is embodied in the "Model D Recorder." Although too complex to describe here at length, the hammer rebound is locked and recorded by means of a ball and hollow cone clutch. This clutch is made passive and active by raising balls in their retainer cage out of jamming contact with the hammer body, or putting them back to jam on downward pressure—no movement in this direction is then possible.

First Cycle (Second Period)

Thus when the hammer is ready to drop, its shoulder rests on the inner flange of the pilot sleeve *E* (see illustration), the upper end of which has just raised the ball cage *G-J* out of clutching contact. This bushing is held up by a hook.



MODEL D RECORDER

Upon releasing the hook, the hammer and its pilot sleeve *E* drop down together. The clutch having been left open, as it were, the ball cage remains up by friction of a band spring *H*.

The hammer strikes first, a moment later, the lower end the pilot sleeve *E*, which falls a little further, strikes the downward extending inner shoulder of the ball retainer sleeve *G*, instantly dropping them in jamming contact with the hammer. The movement of the ball cage sleeve is very short; the last part of its critical period, or just when the balls begin to touch the hammer body, is done at the moment the hammer is brought to momentary rest preparatory to rebounding.

The balls now in position do not retard the rebound but absolutely prevent a reverse motion, hence the slightest rebound is fixed positively and faithfully recorded.

Second Cycle

The hammer *F*, now locked firmly in the hardened cone sleeve K, the ball retainer *G* and pilot sleeve *E* are all raised up together by a rack and pinion by knob *B* to an upper stop *Q*. Here the pilot sleeve catches on its hook *D* and the hammer is brought in contact with the dial hand rack bar *M*, moving it to the extent of the recorded rebound. The spiral spring inside of the knob *B* then holds the clutch hammer and dial hand fixed until the next test is made.

First Cycle (First Period)

The turn of knob forward against its spring causes movements inside which constitute the first cycle. In the first period of this cycle the clutch sleeve, with its hammer still locked in it, is caused to descend. Soon the hammer contacts with the previously hooked up pilot sleeve *E*, where it remains on it as a standard height rest. As the clutch sleeve descends more, the ball cage contacts with the pilot sleeve, de-clutches the hammer and releases the hook so that they drop again for the second test (see first cycle, second period).

Synopsis of Recent Chemical & Metallurgical Literature

Manufacture of Blue Gas

James Hall, of Glasgow, Scotland, presented at a recent gas association meeting operating results from work at the gas plant of that city where thorough test of the efficiency of water-gas operation was made recently. This test was a 24-hour run with two Humphreys and Glasgow carburetted water-gas sets operated as blue-gas generators, using coke as fuel. The operating cycle was 1½ minues blow, 1 minute up-run, 2 minutes down-run, and ½ minute up-steam run. Clinkering five times per set per day occupied from 15 to 50 minutes for a total of 6.16 hours out of the 24 operated. Some of the most interesting results are as follows:

Dry ash-free coke used per 1,000 cu.ft. of blue gas made	33.85 lb.
Heating value of gas (gross)	296 B.t.u. per cu.ft.
Composition of gas:	
H_2	46.8
CH_4	1.4
CO	41.4
O_2	0.1
CO_2 and H_2S	3.1
N_2	7.2
Composition of blue gas:	
CO_2	9.0
O_2	Nil
CO	16.6
N_2	74.4

Further details can be found in *Gas Journal* (London), page 209, issue of Jan. 24.

Automatic Control of Water-Gas Sets

In the current (February) number of *American Gas Association Monthly*, C. H. Stevick presents a history of the development of automatic control of water-gas sets. The article also includes full description of the U.G.I thermal automatic control equipment, the Gas Machinery Co. type of equipment, and the Kennedy automatic control apparatus as made by the Bartlett-Hayward Co. The mechanism thus described is planned exclusively for water-gas apparatus operation, but the methods and apparatus would be adaptable to other types of automatic process control where periodic opening and closing of valves, lids, etc., is necessary. Chemical engineers having problems of this sort will find this review of the subject particularly pertinent.

Electroplating With Cobalt

A few years ago some Canadian research workers in the Canadian Department for Mines created considerable interest by putting forward a proposal to use cobalt as a metal for electroplating in the place of nickel. The results of these researches showed that cobalt could be deposited on brass, iron, steel, copper, tin, german silver, lead and britannia metal, and that the deposits were firm, adherent, hard and uniform, and could be readily polished to a satisfactory finished surface. The cobalt deposited was harder than the nickel and the speed of deposition considerably greater. It was also claimed that its resistance to corrosion was definitely superior to that of nickel, and that the deposits stood satisfactorily all the usual bending, hammering and burnishing tests. The actual weight of cobalt required for a good coating was stated to be about a quarter that of nickel. These claims have not, apparently, been entirely substantiated in British workshop practice, according to *The Engineer* (Jan. 12, 1923), but it is possible to electroplate with cobalt quite satisfactorily and very rapidly. It is considered by that publication unlikely that cobalt will ever attain the industrial importance of its sister element nickel, but it has a peculiar interest of its own, and exercises considerable fascination upon those who work with it.

Recent Chemical & Metallurgical Patents

American Patents Issued Jan. 30, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,443,359 — Fuel and Manufacturing Process. Christian I. Gillstrap, Iowa.

1,443,367—Apparatus for Dehydrating Fruit, Vegetables and Other Materials. Joseph E. Kennedy, New York.

1,443,381 — Accelerating the Vulcanization of Rubber and Method of Producing the Same. Stanley John Peachey, Davenport, Stockport, England.

1,443,439—Process and Apparatus for Introducing Electric Energy Into a Space of Action. George T. Southgate, Washington, D. C.

1,443,454—Process of Manufacturing Paper or Pulp. Lewis Miller Booth, Plainfield, N. J.

1,443,492—Apparatus for Determining the Relative Density of Two Gases. Ross F. MacMichael, Chicago, Ill.

1,443,538—Foam for Preventing Evaporation of Stored Liquids. Frank A. Howard, George H. L. Kent, James M. Jennings, Elizabeth, N. J.

1,443,547—Apparatus for Recovering Solvent. Arthur Samuel O'Neil, Springfield, Ill.

1,443,552—Esters of Trihalogentertiary Butyl Alcohol and Process of Forming Same. Thomas B. Aldrich, Detroit, Mich.

1,443,602 — Preservative Composition. Max G. Weber, Newark, N. J.

1,443,616—Process for Separating Solids by Crystallization from Solvents. Henry Vincent Aird Briscoe, London, England.

1,443,618—Process of Making Coke. William Everard Davies, London, England.

1,443,674—Method for the Treatment of Silicates With Acid in Order to Obtain Saline Solutions Free From Silica. Gian Alberto Blanc, Rome, Italy.

1,443,697—Manufacture and Production of Tanning Agents. Robin Bruce Croad, Liverpool, England.

1,443,707—Roasting of Zinc Sulphide Ores, Preparatory to Leaching. Herbert W. Gepp, Melbourne, Victoria. Australia.

1,443,708—Roasting of Zinc Sulphide Ores, Preparatory to Leaching. Herbert William Gepp, Melbourne, Victoria, Australia.

1,443,714 — Concentrating Process. Oliver Edward Merrell, Syracuse, N. Y.

1,443,735—Mixing Machine. Robert Edmondson, Rochester, N. Y.

1,443,742—Method of and Apparatus for Effecting Continuous Distillation. Francis M. Hess, Chicago, Ill.

1,443,743—Vapor Box or Still for Distillation Systems. Francis M. Hess, Whiting, Ind.

1,443,813—Enamel and Method of Making the Same. Alexander L. Duval D'Adrian, Washington, Pa.

1,443,816—Electric Furnaces. Francis A. J. FitzGerald, Niagara Falls, N. Y.

1,443,881—Fermentation of Cellulose. Herbert Langwell, Stockton-on-Tees, England.

1,443,935—Resinous Product. Louis Weisberg, Grantwood, N. J.

1,443,936—Process of Making a Molding Composition. Louis Weisberg, Grantwood, N. J.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Artificial Silk.—W. O. Mitscherling, of the Atlas Powder Co., Wilmington, Del., has been granted a patent covering a process for the preparation of viscose solutions of cellulose for the production of films or threads whereby the keeping qualities of the solution are improved, and at the same time the product is improved in quality. The ordinary carbon bisulphide viscose solution is quite unstable and gradually decomposes so that the mass sets to a solid jelly in about a week. This of course necessitates spinning before the setting takes place.

The process described in this patent is briefly as follows: The soda-cellulose is treated with carbon bisulphide to form the cellulose xanthate without aging the soda-cellulose and by using a weight of carbon bisulphide, which instead of being from 40 to 60 per cent of the weight of cellulose is only 30 to 32 per cent of that weight. The temperature does not have to be carried so low, the patentee recommending a temperature of approximately 20 deg. C. The cellulose xanthate formed is dissolved without aging in an alkaline solvent containing an amount of caustic soda so that the total amount of caustic soda is not less than the weight of the cellulose and not more by 2 per cent.

In connection with this patent, it will

be interesting to refer to British patent 183,882, which was granted to H. Dreyfus of London on Sept. 27, 1922, and which was abstracted in *Chem. & Met.* on p. 1138 of the issue for Dec. 6, 1922. (1,435,650. Nov. 14, 1922.)

Oil Treatment—An improvement in petroleum refinery methods, particularly as they relate to the washing of mineral oil, paraffine wax and other petroleum products, is described in a patent by Charles F. Kennedy, which has been assigned to the Atlantic Refining Co. of Philadelphia. The purpose of the washing, of course, is to improve the odor or color of the product or to render it non-emulsifying. Recourse is made to a suitably diluted solution of soap such as can be made by the combination of an alkali metal or ammonium salt with those organic or sulphonic acids found in ordinary acid sludge, such as results from the treatment of petroleum or petroleum distillates with strong or fuming sulphuric acid. Another and perhaps better source of these acids is the acid coke or tar which separates from the sludge.

Washing wax-bearing mineral oil or distillates prior to chilling and pressing is said to result in an improved crystalline structure of the wax formed upon chilling the oil, with resultant improved pressing qualities of the oil itself, better and more complete separation of the wax from the filter medium, an improved slack wax and a resultant improvement in the filtered oil.

Thus, in fractionating crude petroleum, as is indicated in Fig. 1, there is a residuum in the still which is heavy wax bearing oil, from which heavy or so-called cylinder lubricating oil may be produced. This residue may be washed with the soap solution previously referred to, and upon reducing its viscosity by the addition of naphtha or other low viscosity oil, it is chilled and the contained solids of the nature of petrolatum separate out more readily. In Fig. 2 is indicated one of the various forms of cracking distillation of crude petroleum, resulting in various cuts or products, any of which may be washed by the solution of sludge acid soap described in this patent. (1,439,171. Dec. 18, 1922.)

Dyes—A new yellow dye which is insoluble in water and in most organic solvents and for which is claimed superior fastness to washing, acids, chlorine and to light, is covered by a patent taken out by Georg Kalischer, Jens Muller and Detlev Nissen, all of Frankfort-on-the-Main, Germany, and assigned to Leopold Cassella & Co., Gasellschaft mit Beschrankter Haftung. This vat dye is prepared by heating methylanthraquinone with sulphur and aromatic compounds which contain the paradiamine-nucleus in their molecule. The paradiamines themselves such as benzidine, p-phenylenediamine and its substitution products are particularly well suited for the reaction. The quantities of the paradiamines of the compounds containing the paradiamine-nucleus may be varied considerably, but the proportion of 2 molecules 2-methylanthraquinone to 1 molecule paradiamine has proved particularly advantageous. The dyes yield olive to brown colored vats with hydro sulphites from which vegetable fibers are dyed greenish to reddish-yellow shades. The new dyestuffs are distinguished from those obtained by heating 2-methylanthraquinone with sulphur alone by their different chemical behavior and also by their superior tinctorial properties. (1,440,833. Jan. 2, 1923.)

Dehydration of Petroleum Emulsions—It is proposed to apply the principles of osmosis to effect a separation of water from emulsions of various petroleum products. In brief, the process consists of separating a body of the emulsion from a body of water by means of a porous diaphragm, and causing a direct current of electricity to flow between these two bodies. The water particles of the emulsion are caused to pass through the diaphragm by osmosis, thus dehydrating the emulsion. (1,440,835. Wynn Meredith, assignor to Petroleum Rectifying Co., of San Francisco. Jan. 2, 1923.)

Recovery of Phenol Vapor—Walter Runge and H. A. Curtis, of the International Coal Products Co., describe in two patents methods for recovery of phenol vapors evolved from solvent recovery processes or from other gaseous mixtures. The first of these patents proposes the use of phenolates, the second the use of suitable tar-oils, such as the material commonly known as "dead oil."

"When the sodium phenolate solution is made by neutralizing a sodium hydroxide solution of greater than 1.07 specific gravity the resulting sodium phenolate solution is miscible with tar acids in all proportions. It is feasible to employ this absorbing function of the sodium phenolate solution to ad-

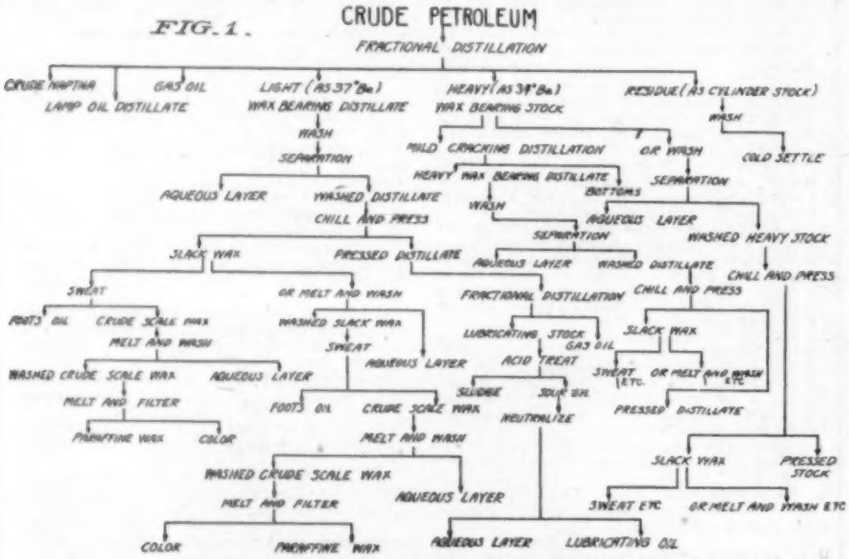


FIG. 1—A TYPICAL SCHEME FOR THE FRACTIONAL DISTILLATION OF CRUDE PETROLEUM

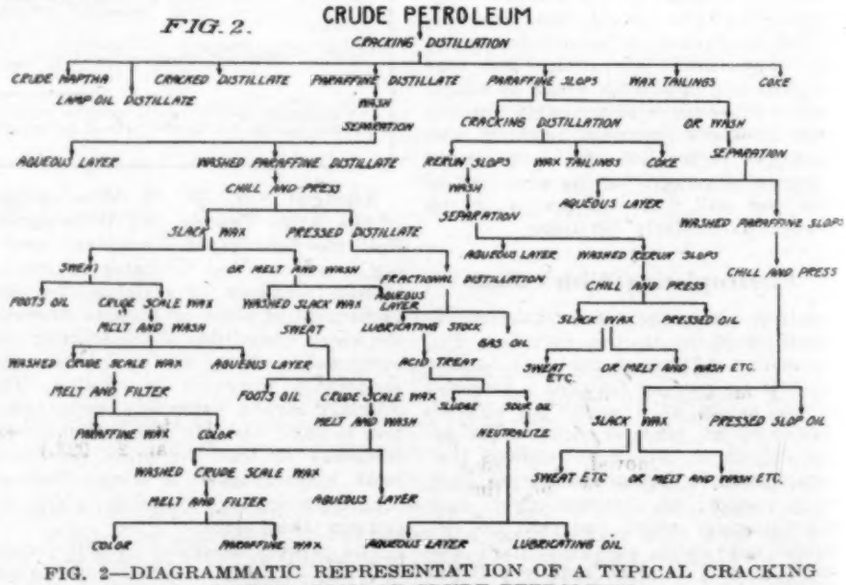


FIG. 2—DIAGRAMMATIC REPRESENTAT ION OF A TYPICAL CRACKING DISTILLATION OF CRUDE PETROLEUM

vantage in the recovering of the phenol-cresol-vapors from the gaseous mixture, and the present process employs the sodium phenolate solution of sodium cresylate solution—of the character specified—as the absorbing agent for the phenol or cresol vapors. The sodium phenolate solution picks up much less carbon dioxide from the air than would be the case with sodium hydroxide or caustic soda. The process may be employed as a continuous process or as an intermittent one."

The second patent, relating to the use of tar-oils, employs oils distilled from tar between 170 and 230 deg. C., preferably oils freed from tar acid.

Both patents are assigned to the Bregeat Corporation of America; and reference to this company's process is made in describing the invention. (1,439,128, 1,440,108, granted Dec. 19, 1922, and Dec. 26, 1922, respectively.)

Purification of Liquors Containing Phenol—Two recent patents, both assigned to the Koppers Co., Pittsburgh, relate to somewhat similar procedures for purification of waste liquor from ammonia stills of coke or gas plants and other waste liquor containing phenol which cannot be discharged to waste because of the damage done in streams, lakes or other water courses. The first of these patents, issued to Ralph L. Brown, relates to the use of certain phenol-destroying micro-organisms which are apparently of the bacterial type for the elimination of phenol apparently by oxidation to other unobjectionable compounds. The operation is conducted by passing the liquor through a filter of humus material properly activated by the presence of the suitable micro-organism. The other invention relates to the use of humus material for filtration with intermittent operation during which the humus material is used and then subsequently revived for re-use. (1,437,394 and 1,437,401, granted Dec. 5, 1922, respectively to Ralph L. Brown and to H. S. Davis and Saul D. Semenow.)

Anesthetic Compound—Roger Adams and Ernest H. Volwiler have patented a process of manufacture of the normal butyl ester of para-amino benzoic acid, an anesthetic compound which may be used locally, internally, for dusting on wounds and for anesthetic purposes in general. The compound is made by the reduction of the normal butyl ester of para-nitro benzoic acid. The latter is prepared by refluxing a mixture of para-nitro benzoic acid and butyl alcohol with a small amount of concentrated sulphuric acid for 8 hours. The reaction mixture is then distilled in a vacuum to remove the excess alcohol, the residue treated with dilute sodium carbonate solution, then extracted with ether, dried and distilled. After the ether has been removed, the residue is warmed up to vacuum for some time to remove the remainder of the normal butyl alcohol. The residue consists of fairly pure normal butyl ester of para-nitrobenzoic acid, which may be crystallized from petroleum ether. This nitro ester is mixed with powdered iron and 20 per cent of hydrochloric acid added gradually, the mixture being kept at about 50 deg. C. during the reduction. The reaction mixture is filtered, made alkaline with sodium hydroxide and extracted with ether. The compound may be crystallized from water or petroleum ether and has a melting point when pure of 57 to 58.5 deg. C. (1,440,652. Jan. 2, 1923.)

Commercial Fertilizer—E. A. Morgan, of Dorchester, Mass., has patented a commercial fertilizer which he claims is exceedingly beneficial. Primarily, it consists in the use of an appreciable percentage of finely ground sulphur in a dry mixed fertilizer. For example, 600 lb. of Canadian hard-wood ashes, 200 lb. of commercial crude potassium carbonate, 400 lb. of powdered sulphur, 400 lb. of sodium nitrate, 300 lb. of ground bone and 300 lb. of acid phosphate make up what might be called a typical formula. Sometimes when a less concentrated fertilizer is desired, a proportion of 5 parts of sifted soil or loam, ground wood, sawdust, etc., to 1 part of the formula is used. (1,440,836. Jan. 2, 1923.)

Method of Controlling Foaming of Boiling Liquids—C. E. Dolbear has assigned to the Industrial Research Corporation of San Francisco the following patent on preventing foaming in boiling liquids. Both petroleum and chlorine individually have some effect on the diminution of foaming, but the author has found that if the lighter boiling petroleum oils (the lighter oils prevent foaming which would be present in the heavier boiling fractions), the so-called "slop distillate" or "tops," are used in conjunction with chlorine (as the element or as chlorite or hypochlorite or other chlorine compound), the foaming is cut down by a very much greater amount. The author has used it particularly on potassium bearing brine. (1,440,973. Jan. 2, 1923.)

Vulcanizable Composition — W. E. Gardner, of Pittsburgh, has patented the following compositions which can be vulcanized to any degree of hardness or softness, depending on the time of heating. Twenty-five per cent of commercial rubber is broken down on the rolls to a consistency of thick molasses, and the following ingredients are incorporated with the rubber by sifting on to the roll: Sixty parts of fine Tripoli or its chemical or geological equivalent, 5 parts of sized mica, 2 parts of hydrated lime and 8 parts of sulphur. The compounding is then finished as usual on the roll and the sheets thus obtained can be treated in any way desired. (1,440,455. Jan. 2, 1923.)

Process and Apparatus for Treating Rubber—G. B. Britton assigned to the Firestone Tire & Rubber Co. a patent on a machine for drying rubber sheets. The washed sheet, thoroughly cleansed, is run through a pair of squeeze rollers and then into a small chamber, where it is treated with a blast of hot air from both sides. From this chamber it passes over a number of heated rolls, finally being wound up in convenient rolled form. It should be noted that the last roller is water-cooled, in order to prevent any bad effect from the rolling of the heated rubber. (1,440,371. Jan. 2, 1923.)

British Patents

For complete specifications of any British patent apply to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Artificial Silk—In the manufacture of artificial threads from an unripened viscose employing an acid coagulating bath, the carbon bisulphide contained in the freshly precipitated acid threads is removed by treating the threads, without previous washing, with an alkaline bath. The threads may be in the form of hanks or layers of yarn, the bath may be maintained at 60 deg. C., and to it may be added a small quantity of sodium sulphide so as simultaneously to remove the sulphur; in that case, only a single washing is necessary. (Br. Pat. 187,942; not yet accepted. Glanzfäden Akt.-Ges., Petersdorf. Dec. 20, 1922.)

Chromium Compounds—Chromite is decomposed by treatment with sulphuric acid and an oxidizing agent, such as chromic acid, at a temperature above 150 deg. C., the oxidizing agent, whether added directly to the reaction mixture or generated *in situ* by electrolysis, being present in amount insufficient to oxidize the iron completely. The chromite may first be treated with carbonaceous matter or a gaseous reducing agent at a red heat and part of the iron then extracted with dilute acid. Under the conditions set forth above, the chromium and part of the iron are converted into insoluble sulphates, from which the chromium is separated by adding a reducing agent to the diluted reaction mixture when the ferric sulphate is reduced, leaving a residue of insoluble chromium sulphate. This compound may be decomposed by boiling in aqueous suspension with caustic alkalis or alkaline earths, alkali sulphides or carbonates, alkaline earth carbonates or ammonia to yield chromium hydroxide or basic carbonate; it may be heated with caustic soda or potash in presence of air and with the optional addition of other oxidizing agents to yield sodium or potassium chromate; or it may be boiled with strong barium chloride or acetate solution to yield the corresponding chromium salt and barium sulphate. Alternatively it may be dissolved in dilute sulphuric acid in presence of ferric oxide and a small amount of oxidizing agent and the solution, after reduction of any ferric salt formed, treated with potassium sulphate for the production of chrome alum.

Instead of first separating the insoluble chromium sulphate, the mixture of

insoluble chromium and iron sulphates obtained in the initial decomposition may be treated directly for the production of chromium oxide.

In one process the mixed sulphates are washed and heated with excess of coal in a reducing atmosphere, a mixture of iron sulphide and chromium oxide being obtained.

In another process, the mixed sulphates are boiled with a slight excess of alkali-sulphide solution and the black precipitate obtained ignited in a reducing atmosphere at red heat.

In a third process the mixed sulphates are calcined and the resulting oxides mixed with coal and heated in a reducing atmosphere.

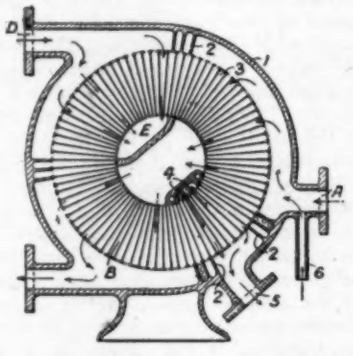
In each case the product is treated with acids to dissolve the iron, and the residual chromium oxide may be dissolved in sulphuric acid in presence of a small amount of oxidizing agent and used for the preparation of other chromium compounds. (Br. Pat. 187,636. C. K. Potter, St. Annes-on-Sea, and F. Robinson, Bolton. Dec. 20, 1922.)

Dehairing Hides—Skins, especially those of rabbits, hares, kangaroos and opossums, are treated for the removal and recovery of the fur and hair without impairing the usefulness of the skins for the production of leather, by immersing them in a solution of sulphite of soda, then in a solution of ammonia, and finally subjecting them to a sweating process. The solution of sulphite of soda is of about 3 per cent strength, and the skins are soaked therein for about 12 hours to remove blood and fatty matter. The solution of ammonia contains about 4 pints of 880 ammonia in 4 gal. of water, and the treatment therewith is carried out in a closed vessel at a temperature of 80 to 120 deg. F. for about 12 hours. The skins are left in the sweating vat for 12 to 24 hours, the time varying according to the strength of the ammonia solution used and the temperature at which the sweating is carried out. The hair is then removed by scraping or brushing, which operation should be carried out as soon as possible after the removal of the skins from the sweating vat. (Br. Pat. 186,608; not yet accepted. G. Duckworth, Victoria, Australia. Nov. 22, 1922.)

Azo Dyes and Chromium Compounds—The chromium compounds of chromable azo dyes described in the parent specification are prepared by treating the dyestuffs in question in alkaline solution with the complex chromium compounds made by action of alkaline suspensions of chromium hydroxide on organic compounds containing more than one hydroxyl group. The process permits the use of iron vessels. According to examples: (1) the dyestuff from diazotized 1-amino-2-oxynaphthalene-4-sulphonic acid and α-naphthol, or that from diazotized 1-oxy-2-amino-4-methylbenzene-6-sulphonic acid and β-naphthol is refluxed with the product made by heating glycerine with caustic potash and chromium hydroxide paste; after diluting with water and neutralizing free alkali, the dyestuff is salted out; (2) the dyestuff from diazotized 1-oxybenzene-2-amino-4-chloro-6-sulphonic acid and 1-phenyl-3-methyl-5-pyrazolone is boiled with the chromium compound from gallic acid or glucose, the free alkali neutralized and the chromium compound salted out. The products dye wool blue, violet or red shades fast to light.

Complex chromium compounds of organic compounds containing more than one hydroxyl group are obtained by heating with alkaline suspensions of chromium hydroxide the parent compounds—for instance, polyhydric alcohols and phenols, tanning agents, sugars, degradation products of cellulose and waste products from sulphite cellulose manufacture; glycerol, glycol, glucose, tannin, gallic acid and phloroglucinol are mentioned. The compounds may in part be separated from their aqueous solutions by evaporation or by salting out. (Br. Pat. 186,635. Soc. of Chemical Industry and F. Straub, both of Basel, Switzerland. Nov. 29, 1922.)

Absorbing Gases — Apparatus in which gases are absorbed by means of charcoal and recovered therefrom and in which the charcoal is prepared for re-use is so constructed that these steps are performed in one continuous operation. The annular sieve drum 3 is subvided by radial imperforate partitions into a series of narrow sectors containing charcoal, and the annular space between the drum 3 and the closed cylindrical casing 1 is divided by partitions 2. Gas entering at *A* passes radially through the charcoal, from which the absorbed constituents are recovered by rotating the drum so that sectors containing absorbed gas are subjected to the action of steam introduced from inlets 4. The mixture of steam and liberated gas leaves the apparatus at 5 for condensation and recovery, any residual gas being returned by the inlet 6. The gas originally introduced at *A* passes again through the charcoal at *B*, thereby cooling and drying the charcoal, and the gas having been cooled, it is passed again through the charcoal by means of the inlet *D* to complete the cooling process, and is finally withdrawn at *E*. The gas streams and the steam current may be applied axially instead of radially, and it is also stated that the system of supply pipes may be rotated. The apparatus is described with reference to the removal of benzene from illuminating gas. (Br. Pat. 187,223. Farbwerke vorm. Meister Lucius and Bruning, Hoechst-on-Main. Dec. 6, 1922.)



Desulphurizing Oils—Petroleum and similar oils are desulphurized by vaporizing the oil to convert the sulphur into sulphuretted hydrogen, and then treating the vapors with water or steam and a gaseous dissociating agent such as chlorine or sulphur dioxide, preferably under the action of a magnetic field. The vaporized oil, steam and dissociating agent are led into a chamber, packed with firebrick, pumice, etc., and surrounded by an electrical coil. The chamber is heated to 300 to 400 deg. C. In an example, the oil is vaporized, and the contained volume of sulphuretted hydrogen is determined. An equal volume of chlorine or sulphur dioxide and five volumes of steam at 240 deg. F. are then admitted. (Br. Pat. 186,738. W. R. Walkey, Westminster, and A. F. Bargate, London. Nov. 29, 1922.)

Food Products From Colloid Mill—Fruit, vegetables, etc., are made into colloidal dispersions in water or other liquid by a mechanical process such as that described in specification 155,836; undesired constituents may be precipitated and the solution concentrated or dried. When grapes are treated, the cellulose may be coagulated by boiling or by alcohol, which may be added or produced by fermentation. Apples may be treated and the juice freed from cellulose by boiling, mixed with sugar and evaporated to form a conserve. In treating beet, impurities may be coagulated by boiling and sugar separated in the ordinary way. Cacao beans may be treated and the solution heated to 60 to 80 deg. C. to coagulate cellulose, lignin, etc. The solution is concentrated by drying with or without sugar and a protective colloid such as gelatine or Iceland moss, and the dry product pulverized. (Br. Pat. 186,756. Plauson's, Ltd., London. Nov. 29, 1922.)

Hydrogen Peroxide—Hydrogen peroxide is distilled from solutions containing or yielding it by bringing the solutions into contact with the highly heated surface of a liquid or a fused salt, the evolved vapors being rapidly condensed. The liquid or fused salt employed is such that it can be heated, without boiling, to a temperature higher than the boiling point of the solution to be distilled, and this having been done, the solution is directed on to the heated surface either as a thin sheet or, preferably, as a spray; a stream of air may be sucked through the liquid to prevent sudden frothing. The preferred material for the heated surface is sulphuric acid or a fused bisulphate, and as examples of solutions which may be treated by the process, the following are mentioned: crude solutions of hydrogen peroxide, sodium, potassium, or ammonium persulphate, persulphuric acid and inorganic peroxides. (Br. Pat. 186,840. Woodlands, Ltd., Dover. Nov. 29, 1922.)

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Bureau of Mines Plans Ceramic Studies

Georgia Clays and Bauxites to Be Investigated in Co-operation With Manufacturers

In the course of the investigation of the kaolins, bauxites and feldspars along the right of way of the Central of Georgia R.R., being conducted by the United States Bureau of Mines at its ceramic experiment station, Columbus, Ohio, under a co-operative agreement with the Central of Georgia R.R., which was recently renewed for another year, the work is being grouped under three heads — whiteware clays, refractory clays and bauxites, and vitrified face brick.

In order to attempt the separation from the whiteware clays of certain deleterious materials, a semi-commercial centrifugal elutriation outfit has been devised by R. T. Stull, supervising ceramist of the Bureau of Mines, and set up at the Columbus station. With this outfit, about 1,000 lb. of clay is washed at one time. Seven clays have been so washed and seven more are still to be washed and tests made on the several separations. The clay washer has proved very satisfactory. The most highly purified material from the several clays burns to a white body free from specks.

Manufacturers to Co-operate

Five hundred pounds of the most promising of these clays will be sent to the Homer Laughlin China Co., at Newell, W. Va., where about eight hundred pieces of china are to be made in accordance with pottery practice. The behavior of these clays, as to working properties, color, percentage loss, etc., will be tabulated.

Some clays which are unsatisfactory for casting and jiggering can be used successfully in dry-press processes; so 500 lb. of one of the washed clays is to be made into tiles at the American Encaustic Tiling Co., Zanesville, Ohio, where this process is used.

Electrical porcelain is to be made from another of the clays at the plant of R. Thomas & Sons Co., East Liverpool, Ohio. The body which is best suited for this purpose is to be worked out and prepared at the station.

Proper dewatering methods will be studied in an endeavor to make both a saving in the time necessary to refine the clay and to improve its slaking properties. In this connection arrangements have been made to have some of the slips washed by the Bureau of Mines put through a Dorr thickener and continuous filter process. The Dorr Co. and the United Filters Corporation are co-operating in the work.

Preheating in order to improve the casting properties of these clays will be tried out, as a preliminary investigation has indicated that this property can be improved by such treatment.

Tests of Impure Bauxites

Great quantities of impure bauxites and bauxitic clays, which have been little utilized up to the present time, are being tested for their utility as material for refractories.

Bricks made from these clays and bauxites have been proved to have a higher fusion temperature than the best grade of firebrick, exceptional hot crushing strength and low spalling tendency. These properties, together with the large range of basicity obtainable in such refractories made from it, should insure a large application.

Tests are under way to prove whether it is not possible to use the same material for the bond as is used in the grog, since this would greatly cheapen manufacturing costs.

The bauxite grog is to be electrically sintered at the Seattle station of the Bureau of Mines. This grog is to be used in the electric furnace refractories.

Refractory Tests

The refractories are to be tested out in electric furnace practice, and bungs for malleable iron furnaces. The refractories are to be made at one of the plants of the Harbison-Walker Co., Pittsburgh, Pa. Mechanical strength, low spalling tendency and resistance to cinder abrasion are prime requisites for this type of refractory.

The electric furnace refractories are to be tested at the plant of the Bonney Floyd Co., Columbus, Ohio, in a Heroult furnace melting alloy steel. The requisites for such refractories are high fusion point and low slag penetration.

The bung brick, which have to withstand considerable heat together with sudden temperature changes, are to be tested at the plant of the Ohio Malleable Iron Co., Columbus, Ohio.

Large deposits of feldspar not sufficiently pure for pottery purposes exist along the right of way of the Central of Georgia R.R. These deposits can probably be utilized, together with some of the white clays, for making a semi-vitreous face brick. It is the purpose of the Bureau of Mines to run an investigation pursuant to the utilization of this material.

Chemical Products From Ruhr Cut Off by Occupation

Latest advices reaching Washington from the Ruhr indicate that practically all hope of any early shipments of chemical products from occupied Germany has been abandoned. Because of the exchange situation, however, it is believed that any stocks of chemicals in unoccupied Germany will be shipped to the United States in preference to other countries.

Manning Will Lead A.C.S. Motor Fuel Symposium

Motor fuels and substitutes will be the subject of discussion at a joint meeting of the gas and fuel chemists and petroleum chemists at the New Haven meeting of the American Chemical Society. Dr. Van H. Manning has consented to preside at this meeting and several well-known speakers will contribute important papers to the discussion. In addition to a résumé of present chemical knowledge in this field, some important new research results on several phases of the motor fuel problem will be included.

British Report on Transmission of Heat

A recent report of the Food Investigation Board of the British Government gives particulars of experiments carried out at the instance of the engineering committee of the board. The primary purpose was to obtain data which would be of assistance in investigations on problems of insulation connected with cold storage construction, but as the work progressed it became somewhat more general in character and a large number of the experiments were carried out as pure problems of engineering.

The process of the transfer of heat by convection of air has been exhaustively investigated, and it is said that the experiments throw new light on the mechanism of convection, especially in connection with the loss of heat from parallel vertical walls with an air space between. It is believed that these results will be of service not only in cold storage work but in various other departments of engineering.

House Approves Federal Sale of Nitrate

Recommends Adoption of Resolution to Authorize Government Sales of Fertilizer and Insecticide

With an amendment extending the period through the calendar year 1924 as well as throughout 1923, the House Committee on Agriculture has reported, with a recommendation for adoption, the Senate joint resolution authorizing and directing the President to procure stocks of nitrate of soda and calcium arsenate and to dispose of them at cost. The resolution also creates a $10,000,000 revolving fund for this purpose.

During and immediately after the war, nitrate of soda was purchased by the government and sold at cost to farmers under authority of the food control act. Charles J. Brand, who was chief of the Bureau of Markets of the Department of Agriculture at that time, testified before the House committee that during 1917 and 1918 120,000 tons of nitrate was purchased in Chile. Only 75,000 tons was received in time to be distributed during the season of 1918. Forty thousand tons of the 1918 purchases remained on hand and was sold in 1919, together with 113,000 tons declared surplus by the War Department and distributed by the Department of Agriculture, the total for the 2 years under this form of distribution being 228,000 tons. The testimony showed that the 1918 and 1919 nitrate deals of the Department of Agriculture involved about $20,000,000 and that the operations were conducted without loss and with a small fraction of 1 per cent gain.

Competition Among Nitrate Importers

B. M. Baruch, former chairman of the War Industries Board, and L. L. Summers, formerly a member of the Munitions Board of the Council of National Defense, told the House committee that competition among importers of Chilean nitrate has been keen and that there have been no evidences of combinations or price-fixing agreements.

The committee amended the Senate resolution to apply to 1924, because the season when farmers purchase both nitrate and calcium arsenate is well advanced for this calendar year.

The report shows that government distribution of nitrate in 1919 represented sales in 38 states from 21 storage points. The normal quantity of nitrate of soda used for agricultural purposes in the United States annually is between 250,000 and 300,000 tons.

The report points out that white arsenic, which is chiefly a product of the copper smelters of the United States, is available only in limited quantities under existing circumstances.

The Department of Agriculture recommends the use of calcium arsenate as an insecticide for the control of the boll weevil. Its use for this purpose began only in 1919 and has increased so rapidly that the supply has not kept pace with the demand.

White arsenic is oxidized to arsenic acid under very carefully controlled conditions. The arsenic acid is then combined with hydrate of lime, both processes under very strictly controlled operation, and by the use of elaborate factory equipment, to produce calcium or lime arsenate. This careful preparation is of the utmost importance, as an improperly prepared product might readily kill a large number of plants.

In 1922 about 8,000 tons of calcium arsenate was sold and did not satisfy the demand. In the manufacture of this tonnage 3,600 tons of white arsenic was required. The probable minimum demand for the present and future seasons is about 12,000 tons of 2,000 lb.

Klein Explains Hoover Stand on Foreign Trade Zones

Criticism of Secretary Hoover's attitude on foreign trade zones and on the exemption from federal taxation of the income of American citizens engaged abroad has led Julius Klein, the director of the Bureau of Foreign and Domestic Commerce, to make the following explanation:

"The kind of products which are most likely to be imported into foreign trade zones for re-exportation are raw materials and certain types of bulk foodstuffs for which, under favorable conditions, we might become distributors. Such products are very largely of a non-competitive nature, many of them being on the free list of our tariff. Furthermore, they are produced, to a large extent, by tropical countries not possessing any considerable merchant marines. It is evident, therefore, that the creation of foreign trade zones could not possibly injure American industry, while, on the other hand, they are likely to benefit our shipping by enabling it to obtain return cargoes. Then, too, the benefit to be derived from free trade zones is not confined entirely to exemption from customs formalities, but is also due to the simplification of shipping regulations which make for a more economical utilization of merchant vessels.

Would Relieve Income Tax Burden

"With reference to the question of tax exemption, Mr. Hoover's proposal contemplates only the provision of relief for those incomes actually earned abroad in professional or trade activities by Americans resident overseas. At present they are compelled to pay in most instances a double income tax, to the United States and to the country in which they earn their income. In the World War states, this double taxation amounts to practical confiscation, and is rapidly driving American citizens out of representation of our commerce abroad. We are, therefore, confronted with the unpleasant prospect of entrusting our commercial interests abroad to the hands of foreigners, which is, of course, undesirable under all circumstances and decidedly dangerous. It is manifestly unjust, as it puts our citizens on a clearly unfavorable footing as against their rivals."

Representative Favors Ford Shoals Offer

Madden, of Illinois, Desires Matter Closed in Businesslike Manner —Has Confidence in Ford

Unqualified acceptance of Henry Ford's Muscle Shoals offer was proposed on Feb. 3 in the House, by Chairman Madden of the Appropriations Committee.

Representative Madden declared he viewed the matter purely from a business standpoint and that his desire was to put the great Alabama project in the hands of a man of demonstrated capacity, irrespective of his politics.

"I know of no person who has demonstrated a larger capacity to handle an undertaking of this magnitude than Henry Ford," declared the Illinois member.

Mr. Madden received an ovation as he concluded, many Democratic members from the Southern states being among those who rose to applaud him.

History of the Project

The appropriations chairman reviewed the whole history of the Muscle Shoals project and declared the issue had narrowed itself down to whether the government would spend another $100,000,000 in completing the dams and plants and putting them in operation or would turn the whole project over to Mr. Ford and receive a "substantial return" annually with a repayment at the end of 100 years of practically what it had spent under the Ford offer.

"We can't stop now," he said. "I feel we owe it to the taxpayers, the farmers and the nation to finish the operation. My own judgment is we should accept the Ford offer and get out of the business so as better to provide for the common defense in time of war and the welfare of the nation."

Pointing out that the government already had spent $107,000,000 on the project, Mr. Madden said estimates were that it would have to expend an additional $84,000,000 to complete it and get it into operation under government control. Under the Ford offer, he added, the government would have to put up another $50,000,000 to complete the dams and other work and then the demand on the Federal Treasury would end.

8 Per Cent Profit on Nitrate

For his part, Mr. Ford, he went on, would agree to operate nitrate plant No. 2 to its present capacity of 40,000 tons of nitrate annually, and in addition would keep the other plant fully equipped and ready for operation in the event of war. Profits on the sale of nitrate to the farmers would be limited to 8 per cent.

"Mr. Ford agrees to pay the government $5,000,000 for the project," he continued. "In addition he would have to put up $59,000,000 to get the whole works into operation, so he would not get such a wonderful bargain."

In concluding Mr. Madden said he had tried not to take sides in the matter but

to state "the plain, unvarnished facts," so that the House might draw its conclusions.

While Representative Madden's announcement that he regards it desirable for Congress to accept Henry Ford's Muscle Shoals proposition did much to stimulate the flagging hope of the advocates of that proposal, it apparently has brought the realization of those hopes no nearer.

It is admitted that this statement from such a prominent member of the House of Representatives is a great asset to the proponents of the Ford offer, but it is an asset which will be of more service in the next Congress than in this, since it is conceded that no vote can be had in the Senate at this session.

Coke Plants Plan to Install New Ovens

It is announced by the Columbia Steel Co. that a byproduct coke-oven plant of 33 new-type Koppers ovens will be constructed near Salt Lake City, Utah, for carbonization of Utah coal. This installation will have a carbonizing capacity of approximately 1,000 tons of coal per day. It will be the first plant installed to carbonize Utah coal in a coke oven.

An extension of the Republic Iron & Steel Co.'s Youngstown plant is planned to include a battery of 61 of the same type combination oven. This battery will be of the standard 12½-ton, 13¾-in. average width oven, designed to carbonize approximately 30 tons of coal per oven per day.

The small gas oven developed some time ago by the Koppers Co. is to be given practical plant trial through the installation of eleven 6¾-ton ovens for the Battle Creek Gas Co., Battle Creek, Mich. These ovens will be 13½ in. wide, designed for an average coking time approximately 12 hours, giving the plant a capacity of about 1½ million cubic feet of gas per day when fired with producer gas. The producer will utilize breeze and small coke and will operate in connection with a waste-heat boiler. Normally the plant will use producer gas for heating the ovens, but any individual oven or the entire battery may be changed over to burn coke-oven gas for oven firing if desired. The new oven corresponds in general type with that which has been tested out during the past year or more at the Chicago By-Product Coke Co. plant, with only such modifications as change in size make necessary.

Reviews Work of A.P.P.A.

Hugh P. Baker, executive secretary of the American Paper and Pulp Association, has opened a tour of the paper-making districts of the South and West, his first address having been delivered before the Virginia manufacturers at the Jefferson Hotel, on Feb. 6. He devoted his talk to a review of the work of the American Paper and Pulp Association, and made public a notable list of accomplishments of the association during the year just closed.

French Purchase of Haber Rights Approved by Deputies

The plan of the French Government to operate a fifty million franc nitrogen and synthetic ammonia plant and its agreement to purchase the rights of the Haber patent from the German Badische Anilin Co. today safely ran the gantlet of the anti-German criticism of members of the Chamber of Deputies, says an Associated Press dispatch dated Feb. 6. Government leaders were confident that Parliament would approve the proposed use of the enormous Toulouse gunpowder plant for the manufacture of fertilizers and gunpowder materials.

Louis Loucheur, former Minister of Reconstruction, was complimented for his success in negotiating for the Haber rights in 1919, for the option on which France paid 2,500,000 francs. The balance is to be paid when the factory is functioning normally. A French engineer has been for 9 months in the Badische Anilin plant watching the process of manufacture. Under the agreement France will be entitled to all developments in the process for 15 years. Under the plan the French Government will rent the Toulouse plant to a private corporation, but will subscribe for one-half of the stock.

Revised Winslow Bill Excludes Chemical Patents

Chemical Foundation Trusts Not Included in Those to Be Returned to Owners

A new bill which represents majority sentiment among the members of the House Interstate Commerce Committee has been introduced by Representative Winslow, to provide for the return by the Alien Property Custodian of certain trusts held by him under the trading with the enemy act. This measure will displace the one on the same subject which has been considered by the committee several months.

The revised bill, broadly speaking, provides for the return of trusts valued at less than $10,000, but no more than that maximum amount shall be returned to any one person regardless of the number of trusts in which he may possess an interest. A new provision is written in this bill stipulating that after its enactment dividends and interest on trusts still held shall be paid to the one for whom the trust is retained.

Excludes Foundation Patents

Exceptions to the bill are patents, trademarks and copyrights which have been "sold, licensed or otherwise disposed of" or which are involved in litigation "in which the United States, or any agency thereof, is a party." This exception excludes from the provisions of the bill all the patents given into custody of the Chemical Foundation, Inc., and all licenses under these patents and the patents previously issued by the War Trade Board, and also excludes various patents held by the War Department and the Navy Department.

The funds still to be held by the Custodian under the terms of the Knox-Porter peace resolution, together with several hundred million dollars worth of former enemy ships, will, in the opinion of administration officials, be a sufficient guarantee of American claims against Germany when adjudicated, although this administration has made it plain that it does not approve of confiscating the remainder of this property to pay these debts. This bill if enacted into law will provide:

1. For the return to their former owners of all trusts of the value of $10,000 and under, and a like sum to be returned to the owners of all trusts whose value exceeds $10,000.

   There are approximately 28,000 trusts held by the Alien Property Custodian valued at less than $10,000 and approximately 2,200 trusts of the value of over $10,000; the total amount to be returned under this item alone will approximate $45,000,000.
2. On and after the passage of the act, all income accruing to the various trusts will be remitted by the Custodian to the former owners or their beneficiaries.
3. All patents that are not the subject of litigation, such as in the suit of the United States Government vs. the Chemical Foundation, Inc., or those that have been sold or assigned to the War and Navy Departments, will be returned by the Custodian.

   This includes patents that are held by the Custodian and have not been sold, assigned or licensed by the previous administration to any government department or the Chemical Foundation.
4. Fugitives from justice are prevented from receiving any return of their property.
5. Another provision permits a corporation, partnership, or association to recover their property if their principal place of business is outside of Germany, Austria or Hungary and the majority of their stock is not owned by individuals of German, Austrian or Hungarian nationality.

   This includes certain banks, corporations, etc., in those nations which formerly were a part of the Austro-Hungarian Empire, and those portions of Germany which are Polish or Danish territory, or Alsace or Lorraine, now French territory.
6. Extends power of the Custodian in deciding expatriation claims.

   This relates to Americans or naturalized Americans who were caught in Germany or Austria at the outset of the war and whose property was seized and who have not satisfactorily explained or satisfied the State Department that they did not expatriate themselves.

No estimate has yet been prepared of the full effect of this bill as revised, Testimony before the committee by Alien Property Custodian Miller showed that there are 28,144 trusts held by that official valued at $10,000 or less each, the return of which would involve $22,122,002, leaving still in custody 2,224 trusts valued at $296,235,899.

Expect New Dye Customs Rules This Month

Special Deputy Appraiser of the Port of New York John Donnelly stated last week that tentative rules and regulations governing the customs appraisal of imported dyes may be issued by the Division of Customs, Treasury Department, prior to Feb. 15. The rules that will be issued will be of a temporary nature only and subject to change where such change may improve the method of ascertaining the tariff values of incoming dyes.

"We want importers and manufacturers to 'shoot' at these rules when they are issued," Mr. Donnelly declared. "This," he continued, "will enable us to perfect them from time to time in accordance with suggestions from interested parties."

The draft of the new rules, as prepared by the appraising officers at New York, were to have been submitted to the Treasury Department last week. It is believed that several days will be consumed by the Treasury in studying the draft as submitted and making any necessary changes. This means, it was explained, that the tentative or test rules will be in operation possibly on or about Feb. 15.

Canadian Experimental Farms Reports Busy Year

In the latest report of the work performed by the Division of Chemistry of the Dominion Experimental Farms in Canada during the past year, details and the results are given of the examination of 4,122 samples sent in for analysis from different parts of the country and including every province. Of these samples, 626 were of soils, 146 of manure and fertilizers, 597 of forage plants, fodders and feeding stuffs, 300 of waters, 2,190 samples of food products from the Meat and Canned Foods Division, and 263 under the head of miscellaneous, including dairy products, insecticides and fungicides.

The investigational work on soils for the Reclamation Service of the Department of the Interior, which was begun 2 years ago for the purpose of assisting in classification of the irrigable lands of southern Alberta and southwestern Saskatchewan, has been continued. The chief object of this work is the determination of alkali, enabling a report to be made upon the lands examined, as to their suitability or otherwise for cultivation under irrigation.

As required and in as far as circumstances permitted, analytical work and research was undertaken during the year for the several branches of the Department of Agriculture, the Post Office Department, the Department of the Interior, Department of Customs and Excise, Department of Marine and Fisheries, Department of Naval Service, and the several commissions and boards in connection with soldiers' civil re-establishment and settlement, so that the division acts as a bureau of chemistry for the entire government service.

New Laboratory Planned for Johns Hopkins

Plans for a new chemical laboratory for the Johns Hopkins University, to be erected at Homewood at a cost of about $600,000, have been completed. The details of the building have not been made public, but it is known that the type of architecture will conform to the Colonial style of the buildings in that group.

New Anode Alloy Cuts Copper Cost

Copper-Silicon Alloy Developed by C. G. Fink Reduces Anaconda Co.'s Costs to 6.4c. Per Pound

From the standpoint of technology, the most interesting and important portion of the annual report of the Anaconda-Copper Minning Co. is the following statement referring to electrometallurgical practice at Chuquicamata: "The solution is electrolyzed with a special copper-silicon anode which has greatly reduced the cost."

At this plant the solution for electrolysis is formed by leaching oxide ores containing about 1.8 per cent Cu with dilute sulphuric acid. In the electrodeposition of copper from such copper sulphate electrolytes ferrosilicon anodes (about 87 per cent Fe and 13 per cent Si) have been largely employed in commercial practice. Lead has also been used. The copper-silicon anodes referred to contain 15 to 25 per cent Si, 2 to 15 per cent Mn, 0.5 to 10 per cent Pb, 0.01 to 10 per cent Ba or Ca, with the remainder Cu.[1]

These have the advantage over ferrosilicon anodes that a normally lower voltage can be used and substantially no iron is introduced into the electrolyte by corrosion of the anode, whereas with ferrosilicon anodes a very considerable contamination of the electrolyte by introduction of iron takes place, and this contamination increases progressively with recirculation of the electrolyte.

Long Life of Anodes

By avoiding such introduction of iron the copper-silicon anode materially decreases the cost of maintaining a low iron content in the electrolyte, since the electrolyte can be used for longer periods of time without requiring purification, thus reducing the acid lost with the impure electrolyte and reducing the amount of impure copper formed. As compared with the use of a lead anode, the copper-silicon anode presents the advantage of increased efficiency, particularly in electrolytes containing iron, inasmuch as lead anodes give extremely low current efficiency with such electrolytes unless special precautions are taken to keep the iron in the ferrous condition. The anode loss is materially less than with either ferrosilicon or lead anodes, with certain electrolytes, particularly copper sulphate electrolytes containing chlorides and nitrate. Owing to the relatively low cost of the anodes themselves in the first instance, and their resistance to breakage during handling and ordinary use, as well as their resistance to anodic disintegration, the process can be carried out for long periods of time, with resulting low cost of operation for the anodes, as well as with economy of operation in low voltage and power consumption and high current efficiency.

Reduction of Costs

Referring again to the annual report of the Chile Copper Co., the cost per pound of copper exclusive of interest, depreciation and depletion dropped from 10.8c. in 1921 to an average of 6.4c. in 1922. In 1915 the figure was 16.34c. Percentage recovery of copper has improved from 66.87 per cent in 1915 to 91.07 per cent in 1921. Present production rate is about 200,000,000 lb. per year, but further extension in the use of the new anodes will probably raise this to 225,000,000 lb. per year by May, 1923.

[1] See U. S. Patents 1,441,567 and 1,441,568, issued Jan. 9, 1923, to Colin G. Fink, assignor to Chile Exploration Co.

Paint Concern Restrained on Misbranding Charge

Misrepresentation in the advertisement and sale of paint was found by the Federal Trade Commission in the case of L. C. Orrell & Co., of Chicago, Ill. It developed in the commission's investigation that the company sold and offered for sale, through catalogs and other literature, ready mixed paints under the principal brand of "Painters' Pure Paint." This brand, the commission found, was represented as "100 per cent pure" and as composed of pure ingredients, whereas the fact was that substitutes comprised the principal component parts of such paints.

By specific terms of the commission's order, L. C. Orrell and Fredericka B. Orrell, co-partners in the Orrell company, are prohibited from using representations of "Painters' Pure Paint" brand or any other paint so offered and sold by respondents.

Chemical Tariff Rate Protests Will Be Heard First

Complaints against the chemical schedule of the new tariff act will be among the first to be investigated by the Tariff Commission, says a dispatch to the New York *Journal of Commerce*.

The commission expects to take up early next week the report of its advisory board with particular reference to the chemical schedule and investigations into costs of production as preliminary to public hearings which are to start shortly thereafter.

Lack of a quorum has delayed the commission in its plans to begin the preparation of recommendations to President Harding under the elastic provisions of the new law. Commissioner Edward P. Costigan is in the West and Commissioner William Burgess is ill, but is thought both will be ready to take up their duties next week.

Explosion Damages Helium Purification Plant

It was not an "explosion of helium" which damaged the purification plant at Langley Field, Va. In an official statement, R. B. Moore, chief chemist of the Bureau of Mines, declared that "there was no helium in the plant at the time of the accident and helium had absolutely nothing to do with the explosion." The accident took place when one of the liquefaction machines was being tested under air pressure.

The plant at Langley Field is intended to purify helium after it has been used in airships. There is some infiltration of air through the gas bag which must be removed periodically to maintain the lifting power of helium. It is for that purpose that the plant is being provided at Langley Field. It has no connection whatever with the production plant at Fort Worth and this accident has no bearing whatsoever on the general helium program.

Engineering Colleges Neglect Social Sciences

Federated American Engineering Societies' Committee Urges Broader Scope for Education

The colleges of the country are urged to "point engineers toward leadership in public affairs" in a report submitted to the Federated American Engineering Societies by its committee on industrial ideals, of which Prof. Joseph W. Roe, head of the department of industrial engineering at New York University, is chairman.

The report stresses the need of the engineer in public life, asserting that he must aid in removing the difficulties of the material world which he has created. Carrying out the idea expressed by Edwin Ludlow, past president of the American Institute of Mining and Metallurgical Engineers, that "this is an engineer's country but a lawyer's government," the report continues:

"For a century, engineers have directed their energy toward the utilization of the physical forces and the materials of nature. The developments which they have brought about have created an epoch in human history.

"While these developments have been of inestimable benefit and modern society could not exist without them, they have introduced many public problems and social readjustments so closely related to the engineer's activities that it is increasingly evident he must assume an active part in their solution.

Need for Public Service

"Recognizing this growing need, the engineers of the country formed the Federated American Engineering societies, primarily to place their knowledge and training at the public service on all public matters affecting engineering, or affected by it.

"Engineering education, reflecting closely the attitude of engineers heretofore, has confined its work almost exclusively to scientific and technical training, giving little if any attention to the social and human aspects of engineering enterprises.

"The Federated American Engineering Societies, therefore, speaking for the engineering profession, urges upon engineering colleges an increased attention to the social aspects of engineering activities and a broadening of their technical training in every way possible, to develop in engineering students the spirit of, and a capacity for, active leadership, not only in industry but in public affairs."

The other members of the committee, whose report has been adopted by the governing body of the Federation, are: Mortimer E. Cooley, dean of the engineering schools of the University of Michigan, Prof. C. F. Scott of Yale University and J. C. Ralston of Spokane, Wash.

Herty Optimistic on the Outlook for Industry

Tells Boston Meeting Ruhr Occupation Will Cut Off German Dyes, U. S. Will Not Notice It

An optimistic view of the present status of the American synthetic organic chemical industry was presented by Charles H. Herty, president of the Synthetic Organic Chemical Manufacturers' Association, in a speech before the Northeastern Section of the American Chemical Society in Boston, Feb. 10.

"The economic struggle now in progress between France and Germany will, in all probability, result in the cessation of exports of German dyes and other synthetic organic chemicals, just as the blockade of German ports during the great war cut off all German chemical exports in 1916," said Dr. Herty. "It is very plain that with the Ruhr Basin isolated, thereby shutting off the coal needed for power and the essential raw materials, with transportation demoralized throughout the Rhine territory, which is the center of the dye and chemical industry in Germany, and, finally, with upset labor conditions as the result of French occupation, the crippling of the German chemical industry must necessarily follow, unless reparations questions are quickly settled by France and Germany."

Pre-War Conditions Changed

The blockade of 1916 found the American textile industry in a very embarrassing position, for there was then in this country barely a few months' supply of necessary colors, and no factories, or even a nucleus of an industry prepared to make dyes and chemicals. These facts are too well known to need repetition here. The American chemical manufacturer can justifiably point with pride to the condition which exists today, with an American synthetic organic chemical industry ready to supply practically the entire needs of the country. As a matter of fact, the American consumer would scarcely feel the result of the complete stoppage of German colors, so well has the American industry progressed during the 6 years of its existence.

Corn Products Acquires "Sealite" Rights

Newly Developed Substance for Preventing Oil and Gasoline Evaporation Was Perfected by Standard Oil Co.

Formal announcement has just been made that the Corn Products Refining Co. has acquired from the Standard Development Co., a Standard Oil subsidiary, control of all the rights of "Sealite," the newly developed preparation used to prevent evaporation of oil in storage and to minimize the danger from lightning. Negotiations have been under way for some time for the control of the product. The amount involved in the transfer was not made known.

Development of "Sealite"

The product "Sealite" represents the result of several years' research and development work by the technical staff of the Standard Oil Co. of New Jersey. The patents have been owned by the Standard Development Co. The product went into general use in the refineries of the Standard Oil Co. of New Jersey and its subsidiaries last year.

The principal constituents of "Sealite"—glucose, corn starch, glycerine, calcium chloride and glue—are produced by the Corn Products Co. at its various plants in the United States, and arrangements have been concluded to produce the "Sealite" itself at these plants so that it may be delivered to the petroleum refining and producing industry at a minimum cost.

Properties of Compound

It is explained that "Sealite" is a highly viscous fluid weighing approximately 4.75 lb. per gallon and having the appearance of a thick white paint. Although its viscosity increases at low temperatures, it flows freely down to 25 deg. F. It can be pumped, but only with great difficulty due to its high viscosity. Some of its constituents are of a drying character and some of a hygroscopic character, the proportions being so balanced that the material neither loses nor gains water upon exposure to the air. Tests and experience justify the conclusion that it is unaffected by atmospheric conditions.

It is chemically neutral, faintly sweet in odor and taste, non-poisonous, noncorrosive, and would be rated as noncombustible, although it decomposes under extreme temperatures, as do all organic materials. It is soluble in water in all proportions and insoluble in any petroleum oil in any proportion. It does not impart any color or odor to either crude or refined petroleum products. It is not subject to fermentation or decay.

New Society Formed to Champion Chemist

American Institute of Chemistry Will Devote Efforts to Promotion of Economic Status of Profession

The American Institute of Chemistry, an organization with the announced objects of aiding in the establishment of the professional status of chemists and promoting their economic interests, was formally organized on Feb. 5 in New York City. Constitution and bylaws were adopted and temporary officers elected.

The general purposes of the organization, as stated in the constitution, also include the compilation of a code of ethics and the promotion of popular appreciation of chemical research and control in the industrial field. The efforts of the Institute are to be devoted primarily to the interests of chemists rather than to the interests of the science. In a general way the functions of the new society will follow the model of the British and Canadian Institutes of Chemistry.

No Conflict With Present Societies

"It is not the intention of the Institute to encroach upon the fields of usefulness of the American Chemical Society, the American Electrochemical Society or the American Institute of Chemical Engineers," says a statement of the president, Horace G. Byers. "On the contrary, it earnestly seeks the cooperation of these agencies in their fields of usefulness with the efforts which the Institute will make in its own.

"The Institute does not propose to enter the field of publication in any connection either directly or indirectly," continues the statement, "and it hopes to be mutually helpful to all the agencies of publication of chemical information which are now serving the public. The scientific papers presented at its meetings will seek publication in the present journals and every effort will be made by the Institute to co-operate with existing agencies for the benefit of the profession."

Its objects appeal naturally more strongly to the younger men, and development will doubtless be guided largely by their influence.

Temporary Officers

Temporary officers were elected as follows: President, Horace G. Byers; vice-president, Lloyd Van Doren; treasurer, Clarence K. Simon; secretary, Lloyd Lamborn.

Councilors were selected as follows: Ralph E. Lee, L. R. Seidell, F. D. Crane, L. W. Parsons, H. L. Lourie, Casimir Fink, L. J. Matos, Miss C. M. Hoke, Stanislaus Skowronski.

Membership of the new organization is to consist of fellows, associates and juniors. Fellows will comprise those who have had training equivalent to the B.S. degree in chemistry and a minimum of 5 years of experience. Associates must have the above educational training and juniors may be undergraduate students.

Personal

RICHARD V. AGETON, of the Bureau of Mines, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the bureau.

Prof. W. L. BADGER, professor of chemical engineering, University of Michigan, Ann Arbor, Mich., is taking a year's leave of absence beginning Feb. 1. He expects to continue his research work on evaporator design in Ann Arbor.

Dr. MARSTON T. BOGERT, professor of chemistry in Columbia University, gave a lecture at Connecticut College for Women, New London, Conn., on Jan. 23 on "Synthetic Dyestuffs and Their Bearing on the Life of the Individual and of the State."

HENRY T. CHANDLER, chemical and metallurgical engineer, has become connected with the Vanadium Corporation of America as metallurgical engineer, with headquarters at Detroit, Mich. He was formerly with the Ford Motor Co. as research engineer and more recently was connected with C. H. Wills & Co., Marysville, Mich., manufacturers of automobiles.

PERCIVAL CHRISTIE has been elected president of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., succeeding the late Knox Taylor. He has been vice-president and treasurer of the company for a number of years. Mr. Christie will also act as president of the William Wharton Co., Easton, Pa.; the Tioga Steel & Iron Co., and the Philadelphia Roll & Machine Co., both of Philadelphia, subsidiary organizations.

WIGGINGTON E. CREED, president of the Columbia Steel Corporation, Pittsburg, Calif., gave an interesting address on the progress of the steel industry at the weekly luncheon of the Down Town Association, San Francisco, on Jan. 25.

H. R. HANLEY has been appointed associate professor of metallurgy at the School of Mines and Metallurgy, Rolla, Mo.

Dr. ELLWOOD HENDRICK spoke at the Sterling Laboratory, before the New Haven section of the A.C.S., New Haven, Conn., Feb. 13, on "Obligations in Chemistry."

JOHN M. HOOD, JR., president of the Crown Cork & Seal Co., Baltimore, Md., has resigned.

HERMAN LIVINGSTON and PAUL MCMICHAEL, chemical and mechanical engineers, have opened an office in the Woolworth Building, New York City.

Dr. THOMAS MIDGLEY, JR., research engineer of the General Motors Research Corporation, has unfortunately contracted organic lead poisoning from his work on lead compounds used in preparing anti-knock motor fuels. Although Dr. Midgley's condition is not at all serious, he is on leave for an indefinite vacation to recuperate.

GEORGE SOUTHGATE has resigned from the Bureau of Soils, Washington, D. C., to accept a position with the Federal Phosphorus Co., Birmingham, Ala.

Dr. P. V. WELLS of the optics division of the Bureau of Standards, has resigned to take up research work for E. I. du Pont de Nemours & Co., Parlin, N. J.

Obituary

EVERETT C. BRITTON, an official of E. I. du Pont de Nemours & Co., Wilmington, Del., died at his local residence, Jan. 29, from pneumonia. He was 38 years old. His entire business career was spent with the du Pont organization, and for some time he acted as assistant to the director of the high explosives operating department.

DAVID COCHRANE, of the H. S. B. W. Cochrane Corporation, Philadelphia, Pa., the inventor, designer and first builder of the open-feed water heater which bears his name, died Jan. 24. Mr. Cochrane was born in Sawkey, Clackmanmonshire, Scotland, in 1850, and in his early years worked as a pattern maker on the Clyde. In 1879 he came to the United States, where he entered the employment of Ferris & Miles, but shortly afterward went with the Harrison Safety Boiler Works, then the builder of a sectional cast-iron boiler. His open heater, brought out in 1883, was specifically designed to protect boilers from the effects of cold, unpurified feed water, and was itself the first to be built of cast-iron plates, to avoid corrosion. Mr. Cochrane was also the first to design a successful oil separator, a heater and receiver, and other appliances which have since become standard practice. He was distinguished by great common sense in engineering matters and had a peculiar capacity for winnowing the wheat from the chaff and for simplifying construction. He was frequently consulted concerning the design of steam plants and his great contribution to steam engineering consisted in focusing attention upon the more efficient utilization of exhaust steam for heating buildings and for heating and purifying water to be used for feeding boilers and for industrial purposes. As early as 1894 he advocated the withdrawal of steam in course of expansion for feed heating and similar purposes, thus anticipating the present-day movement to provide all large turbines with bleeder connections.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities Prevailing Prices and Market Letters From Principal Industrial Centers

What Shall We Do About Immigration?

Leaders in Commerce, Finance and Industry Contribute Their Opinions to Symposium of National Manufacturers Association—Recommend Changes in Law

PROBABLY no single economic question in this country is being so widely discussed at the present time as the fundamental problem of immigration. Current shortages of labor, particularly in the metal industries and building trades, have served to focus attention on our present immigration law and its operation under conditions that may be regarded as approximately normal.

In view of the timely importance of the subject, the National Association of Manufacturers recently sent out an inquiry asking a large number of representative men the question: "What shall we do about our immigration?" Forty-six responses were received from presidents of corporations, agricultural leaders, heads of great rail and water transportation systems, bankers, college professors, financiers and immigration specialists. The replies were practically unanimous in recommending that the present 3 per cent quota law be amended.

Constructive Suggestions

In addition the following constructive suggestions have been picked out as summarizing the recommendations most generally agreed upon:

The quota should be determined with the ultimate object of obtaining net immigration, and not according to the present method which in many instances causes a deficit of labor.

The Secretary of Labor should be authorized, on the presentation of satisfactory evidence of a shortage of labor in any industry, to bring about the admission of desirable immigrants to fill the special need.

A scientific selection of immigrants should be made by United States officers, on the other side of the ocean, so that intending immigrants who do not qualify may be rejected at the port of embarkation.

A centralized bureau or commission should be set up, so that all matters respecting immigration may be handled by it in the most expeditious, efficient and practical way.

The adoption of a more definite policy in the registration and distribution of the immigrants.

The nation should extend and make more humane its method of receiving immigrants.

A broader method of immigrant education is needed; one that will take him from the time of his entry and guide him properly for his naturalization.

Abolition of the literacy test.

Among those who contributed to the symposium were Judge Elbert H. Gary, W. W. Husband, Commissioner of Immigration; Frederick A. Wallis, former Immigration Commissioner at the Port of New York; Prof. Albert Shields, of Columbia University; Frederick Underwood, president of the Erie Railroad; Lee J. Eastman, president of the Packard Motor Co. of New York, and C. H. Markham, head of the Illinois Central system.

Legislative Proposals

It is interesting to know that the Immigration Committee of the House of Representatives is now considering and is reported to be in practical agreement on a tentative redraft of the present immigration law. It is suggested by the committee that the 3 per cent quotas based on foreign nationals resident in this country in 1910 be changed to 2 per cent on the basis of the 1890 census. This would have the effect of sharply reducing the allotted number of immigrants from Italy, Greece and southeastern Europe, but it is reported that other features of the bill will so liberalize the present law that at least 200,000 more aliens than are now permitted will be allowed to enter. This would increase the present maximum to about 550,000 per year, it is estimated.

To meet any shortages of skilled labor which may develop after the quotas are filled the Secretary of Labor would be authorized to admit workers in the groups needed when labor of like kind can not be found in America.

Aliens returning from temporary visits to their home lands, the number of which may likely run as high as 75,000 a year, are not counted in the quotas, as is now provided.

Broad exceptions are established for the foreign kin of American citizens or the close relatives of permanently admitted aliens.

Another exception includes immigrants who have resided for 5 years in contiguous territory, with their wives and children, provided they accompany them.

The Immigration Committee abandoned the idea of introducing the examination of aliens at the source, as well as the literacy tests.

However, in order to obtain a consular certificate required for entry the alien must fill out a form which in itself is a sort of literacy test.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	175.64
Last week	175.08
February, 1922	148
February, 1921	166
February, 1920	252
April, 1918 (high)	286
April, 1921 (low)	140

As the result of a typographical error in our issue of Feb. 7, 1923, this index was reported as 175.08 for "last week" (Jan. 31, 1923) and the proper quotation for that week was omitted. Correct figures for this index since the first of the year are as follows:

Jan. 3, 1923	171.30
Jan. 10, 1923	172.79
Jan. 17, 1923	171.71
Jan. 24, 1923	174.21
Jan. 31, 1923	175.15
Feb. 7, 1923	175.08
Feb. 14, 1923	175.64

Chemical Price Changes During January

Most of the price changes that occurred during January have not been of a fundamental character and in most instances were the result of current developments. The outstanding feature of the list was arsenic. The demand for calcium arsenate producers brought prices up from 15c. per lb. to 15½c. Bleaching powder was also advanced by leading producers to 2c. per lb. The resale market advanced from 2c. per lb. to 2½c. Importers of caustic potash showed a strong tendency to increase quotations and prices recorded a net advance of 1c. per lb. during the month. Early in January quotations ranged around 6¼c. per lb. and during the latter part of the month prices advanced to 7¼c. per lb. Carbonate of potash also advanced from 5½c. per lb. to 6c. Permanganate of potash showed a gain of 1½c. per lb. for the month. Quotations opened at 16c. per. lb. and gradually advanced to 17½c. Producers announced an increase of 1c. per lb. on acetate of lead during January. Ammonium nitrate was sharply advanced due to the sold up condition of producers and the inability to import large quantities. Prices late in January were around 10½c. per lb.

There were only a few declines. Oxalic acid, barium chloride, citric acid, red prussiate of potash, prussiate of soda and acetate of soda showed slight reductions during the month. The transportation situation has had a strong effect on many commodities. On the whole chemical prices have been well maintained and producers are confident that business will show material expansion in the next few months.

New York Chemical Market Lacks Important Features

But Few Significant Price Changes as Business Reflects an Unusual Lull —Shipping Conditions Improved

NEW YORK, Feb. 10, 1923.

Although on the surface the chemical market in New York City has been practically featureless during the past week, there is nevertheless abundant evidence that underlying conditions are fundamentally sound. The consuming trades continue their activity and the fact that there has been a temporary lull in buying does not necessarily mean that the consuming demand has been supplied.

The shortage of freight cars reported in these columns last week has been considerably relieved and as a result the alkali and heavy chemical producers are again able to make fair-sized shipments.

Arsenic and its compounds continue to be in demand and dealers are very firm in their belief that prices will reach much higher levels before spring. Lead arsenate has been advanced because of the strong demand from the insecticide trade. Importers of white sal ammoniac, sodium sulphide, lump potash, alum and sodium fluoride quoted fractionally lower prices in an effort to attract new business. Carbonate of potash, caustic potash, permanganate of potash, salt cake, prussiate of soda and bleaching powder continue along moderately active lines at former levels.

Principal Price Changes

Acetic Acid—The general tone was quite steady, with 28 per cent material quoted at $3.15 per 100 lb., carload lots. Glacial was held at $12 per 100 lb. in barrels.

Acetic Anhydride — Manufacturers announced lower prices for this material. The general range was around 36@38c. per lb. The demand, however, was somewhat unsteady.

Arsenic—Resale goods were reported firm at 15¼c. per lb. The general market is very strong, although a few odd lots are selling at slightly lower figures. Future shipments were held around 16c. per lb.

Barium Chloride—Leading importers offer spot goods at $90 per ton. Shipments quoted around $85. Domestic factors quote $95. Market rather irregular.

Bicarbonate of Soda — Producers quote the market around $1.75 per 100 lb. in barrels and $2 per 100 lb. in kegs, f.o.b. works. The general movement is of a routine nature.

Calcium Chloride — Manufacturers report transactions for the granular at 1¼c. per lb. Fused material is quoted at $20@$21 per ton, f.o.b. works.

Carbonate of Potash—Imported material continues quite firm, with dealers quoting limited quantities of calcined 80-85 per cent at 6c. per lb. and 96-98 per cent at 7@7¼c. per lb.

Caustic Potash—Several fair-sized lots have been sold at 7¼@7¼c. per lb. for the imported 88-92 per cent. Shipments are quite difficult to obtain below 7¼c. per lb. c.i.f. N. Y.

Caustic Soda—Export business is without any special feature and prices for standard goods range around $3.45@$3.50 per 100 lb. Railroad shipments have been somewhat improved and consumers have been able to purchase at 3¾c. per lb. for prompt shipment. Contracts continue at 2¼c. per lb., basis 60 per cent f.o.b. works.

Lead Arsenate—Producers report a very firm market, due to the increased demand from the insecticide trade. Sales of powdered recorded at 23c. per lb., with the paste at 12¾c.

Muriatic Acid — A slightly firmer market was noted for the lower grade and producers were not inclined to shade 90c. per 100 lb. for the 18 deg. acid in tank cars. The 20 deg. acid held at $1 per 100 lb.

Nitric Acid—Manufacturers report sales of the 36 deg. at 4¼c. per lb. in carboys. Smaller lots command from 4½@5c. per lb. The 42 deg. test was held at 6c. per lb.

Prussiate of Soda—A slightly better tone was noted in this market and dealers were not inclined to shade 19c. per lb. for spot goods. Shipments from abroad held firm at 20c. c.i.f. N. Y.

Linseed and Cottonseed Oil Advance

The general tone of the market continued along very steady lines, due largely to the firmness in cottonseed and linseed oils. Most prices were unchanged, but dealers were quite certain that materially higher quotations would be seen before the spring season sets in.

Linseed Oil—Leading crushers announced another advance for February shipments, due to the pronounced scarcity of spot and nearby goods. Quotations range around 96c. per gal. Futures were advanced in proportion to the spot price.

Castor Oil — Prices showed practically no change for the interval, with AA quoted at 12¾c. per lb. and No. 3 at 12¼c. per lb. Demand continues along moderate lines.

China Wood Oil—Demand continued along very steady lines, with spot goods quoted at 18c. per lb. February-March shipments were held at 17½c. Nearby shipments from the coast in sellers' tanks were quoted at 15@15½c. per lb.

Company Dividends and Financial Notes

Standard Oil Dividends. On Feb. 7 the Standard Oil Co. of Indiana announced a quarterly dividend of 62½c., which is an increase of $1 per year over the rate paid on its old stock prior to the recent 100 per cent stock dividend. The old rate was $4 a year; the new is $2.50, equivalent to $5 on the old stock.

On the same day the Imperial Oil Co., Ltd., of Canada, which is owned by the Standard Oil Co. of New Jersey, declared an extra dividend of $1 per share. If this is made a permanent quarterly feature the stock will be on a basis of $7 per year.

Ingersoll-Rand. The Ingersoll-Rand Co. has declared a quarterly dividend of 2 per cent on its common stock, payable March 1 to stockholders of record Feb. 17. This company had declared a 100 per cent stock dividend last December, prior to which time the quarterly rate had been 2½ per cent.

Eastman Kodak. The directors of the Eastman Kodak Co. recently declared the usual quarterly dividend of $1.25 a share and in addition an extra 75c. dividend on the common stock payable April 1.

American Hide & Leather Profits. The report of the American Hide & Leather Co. for the quarter ended Dec. 31, 1922, shows a net income of $294,875, which is equal to $2.35 per share on the $12,548,300 of preferred stock This compares with a net income of $268,209, or $2.13 per share, in the preceding quarter and $207,601, or $1.65 per share in the corresponding quarter of 1921.

In 1921 this company reported a deficit of $550,257, while in 1922 the net income amounted to $1,022,660. It should be pointed out, however, that the latter figure includes an extraordinary income for fire loss of $495,000.

Satisfactory Business in St. Louis Market

Most Chemical Prices Are Firmly Maintained—Higher Alkali Prices in Prospect—Citric Acid Lower

ST. LOUIS, MO., Feb. 6, 1923.

A very satisfactory volume of business was transacted in this market during the month of January, and the activity has continued this month. The character of this business is very sound, which is accounted for by the firm market which has maintained for some time. Stocks in general are adequate, although a few articles are reported short in some directions. Transportation is still an obstacle confronting the shipper and very little improvement is expected before spring, as weather conditions during the winter months greatly hamper the operations of the railroads.

The chaotic condition in Europe has made no material change so far, but if the occupation of the Ruhr district is prolonged there will be a shortage of supplies of articles coming from this district, and consequently higher prices will be forthcoming.

Good Trading in Alkalis Reported

The market on alkalis continues firm, with a good volume of business being transacted. Prices have not changed, but a slight rise would not come as a surprise. *Caustic soda* is still being quoted at $3.90 per 100 lb. for the solid, and $4.25 per 100 lb. for the flake in 5-drum lots delivered to the buyer's door.

Quotations on carload lots would indicate about $3.40 per 100 lb. f.o.b. this market for the solid. *Soda ash*, 58 per cent light, is being quoted at $2.10 per 100 lb. in 5-bag lots, $2.30 per 100 lb. for 5 barrels. This has been shaded in one or two instances, but this price generally prevails. Carload lots sell around $1.55 per 100 lb. in bags f.o.b. shipping point. *Bicarbonate of soda* is holding firm and the best that can be done on less than carload quantities is $2.25 per 100 lb. on truckloads delivered. The 5-bbl. price is pretty generally $2.40 per 100 lb. *Sal soda* is in good demand at $1.55 per 100 lb. in barrels, $1.85 in kegs, $2 in cases—90 lb. in 2½-lb. packages.

General and Special Chemicals

Heavy mineral acids continue to move in good volume, particularly *muriatic*, and producers report being sold ahead over the next few months. Last week leading manufacturers announced an important reduction in the price of *citric acid* which was said to be due mostly to foreign competition. The reduction brought the price of crystals to 50c. per lb. and powdered to 51c. per lb., both in barrels, f.o.b. St. Louis, with the usual ½c. advance for kegs. *Citrates* remain unchanged, although citric acid declined. The demand for *tartaric acid* is nil, while *cream of tartar* has been more active. There are no special changes reported in *white arsenic*. Supplies are still very scarce and many users are buying as far ahead as 6 months so as to insure them of supplies when needed. *Carbon tetrachloride* and *bisulphide* are both moving in fair volume and remain unchanged in price. There is now a big demand for *creosotes* and *guiacols*. *Glycerine* continues in an unsettled state, and such a thing as an established market price does not exist—17@18½c. and anywhere between is considered a satisfactory price. *Cyanide of potash* is very firm, with a good demand. Red and yellow *prussiate of potash* are moving in larger volume. *Potassium permanganate* is very strong, with a good demand, and an advance in price in the very near future would not be surprising. *Sulphur* has not gained noticeable strength since our last report. A fairly good volume of business has not as yet brought about any strength in price, which continues very low. *Zinc sulphate* is quiet and very firm and the market is quoted at 3½c. f.o.b. St. Louis in carloads. *Zinc dust* is also quiet and firm with an increased inquiry, and the market is quoted at 10c. in carloads f.o.b. St. Louis.

Vegetable Oils and Paint Materials

Castor oil is maintaining its position of firmness attained a short time ago and a good volume of business is being done at 14c. in drums. *Turpentine* has declined sharply and is being quoted today at $1.43 in 5-bbl lots. *Linseed oil* has taken the expected advance, the prevailing price being $1.06 for the raw oil, $1.08 for boiled oil in single-barrel lots. In 5-bbl. lots a differential of 10c. per gal. prevails.

Advancing Tendency Continues in Steel Market

Increasing Strength the Result of Better Prices, More Business and Active Inquiry

PITTSBURGH, Feb. 9, 1923.

There is a still more pronounced advancing tendency in the steel market. In fact, the advancing tendency has been growing constantly since it first appeared about Jan. 1. Measured by prices, the steel market is stronger than ever. Measured by volume of business on books, it is likewise stronger than at any previous time in this movement. Measured by volume of inquiry, the market appears almost as strong as at any time. By still another symptom, the actual volume of sales and purchases, the market is decidedly quieter.

When the mills are not well sold up, inquiries and sales are much the same. When they are, the apparent volume of inquiry may greatly exceed the transactions, on account of many mills refusing to quote and an inquiry having to go the rounds before finding a seller, thus being magnified in apparent volume. A number of mills have been refusing more business than they have been accepting.

Production to Reach Maximum

Maximum steel production will probably be reached next month. Outputs have been increasing slightly in the past few weeks, with slowly increasing labor supply, due to intelligent employment effort, and with smoother operation of mills, from practice. March is almost always a month of high outputs, on account of weather conditions. After March labor shortage is likely to be a factor. A great deal of new construction is planned, and it is practically certain that not a few workmen will be drawn from mills by bonus wage rates.

Steel ingot production was at a rate of about 40,000,000 tons a year in each of the last 3 months of the old year. The rate has been increasing since December and it is far from improbable that a rate of close to 45,000,000 tons will be attained next month.

There is no particular scarcity of any finished steel commodity. The steel industry evidently has its old-time flexibility, with a finishing capacity well in excess of steel-making capacity, so that finishing departments can be operated in relation to the demands for the various products.

While no formal action seems to have been taken, it appears that the Carnegie Steel Co.'s price on shapes and plates has been advanced from 2.10c. to 2.20c. in the past week, following a definite advance in January from 2c. to 2.10c. The company's usual quotation on bars is 2.10c., but order books are so well filled that little tonnage can be taken. A large independent, on the other hand, is quoting 2.10c. on shapes and 2.20c. on bars. There is no single price quotable, much depending on tonnage, time of delivery and relation between mill and prospective buyer.

Late last week several independent pipe mills advanced prices two points on merchant steel pipe, three points on oil country goods and about $6 a ton on oil country goods. The Steel Corporation followed with similar advances. Nominally a point in merchant pipe discount is $2 a net ton, but on account of the trimmings it amounts to about $1.85. In the present advance one trimming, the last discount of 2½ per cent, was eliminated, so that the actual advance in merchant pipe averages slightly over $5 a net ton. The new basing discount is 64 per cent, the basing discount at the low point a year ago being 71 per cent. The total advance has been in the neighborhood of $15 a net ton.

For months past there has been some divergence in prices quoted on hoops and bands, according to width and gage. The divergence arose from the fact that with greatly advanced labor cost the old schedule of extras does not cover additional cost on the lighter material, weighing in some cases only a few hundred pounds per mile. Of late the irregularities have crystallized into two base prices, one, 2.75c., applying on bands and on hoops 1-in. and wider and 20 gage and heavier, the other, 3.50c., applying on lighter material. While this makes quite a difference between 20 and 21 gage, the mills are averse to tampering with established extras. A similar gap occurs between flats ¼-in. and ⅜-in. respectively, the former being a bar and the latter a band.

Nearly all the independent sheet mills have now withdrawn from the market, being sold up to April 1 or later. These mills did not wish to fill up unduly prior to an advance in prices, but were not as ready as on former occasions to make formal announcement of advances. In a few cases mills have been quoting higher prices. It is taken practically for granted that prices will advance $3 or $5 a ton from the market level generally prevailing of late, 2.50c. for blue annealed, 3.35c. for black and 4.35c. for galvanized. Some mills have been disposed to increase the spread between black and galvanized from 1c. to either 1.10c. or 1.15c., on account of the high cost of zinc.

Coal and Coke

Market prices of Pittsburgh coal, Connellsville coal and Connellsville coke have declined slightly in the past week. In coal the decline is less than would be expected from the decreasing demand of the past few weeks, a supporting influence being car shortage, for car supplies in the Pittsburgh district have averaged decidedly less in the past 30 days than during December. Pittsburgh coal is now quotable at $2.75 for steam mine-run, $4.50 for nut and $4.25 to $5.00 for lump. Connellsville byproduct is quiet at about $3.50.

Demand for coke for heating purposes has been decreasing, but is still of fair volume. All prices are down about 50c. in the week, at $6.50@$7 for heating, $7.50@$8 for furnace and $8.25@$8.75 for foundry.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0.36 –	$0.38
Acetone, drums	lb.	.21 –	.21½
Acid, acetic, 28%, bbl. 100	lb.	3.15 –	3.40
Acetic, 56%, bbl. 100	lb.	6.25 –	6.50
Glacial, 99½%, carboys 100	lb.	12.00 –	12.50
Boric, crystals, bbl.	lb.	.11½–	.11¾
Boric, powder, bbl.	lb.	.11 –	.11½
Citric, kegs	lb.	.49 –	.50
Formic, 85%	lb.	.15 –	.17
Gallic, tech.	lb.	.45 –	.50
Hydrochloric, 18° tanks, 100	lb.	.90 –	1.00
Hydrofluoric, 52%, carboys	lb.	.12 –	.12½
Lactic, 44%, tech., light, bbl.	lb.	.11 –	.11½
22% tech., light, bbl.	lb.	.05 –	.05½
Muriatic, 20°, tanks, 100	lb.	1.00 –	1.10
Nitric, 36°, carboys	lb.	.04½–	.05
Nitric, 42°, carboys	lb.	.06 –	.06½
Oleum, 20%, tanks	ton	17.00 –	18.00
Oxalic, crystals, bbl.	lb.	.12½–	.13
Phosphoric, 50% carboys	lb.	.08 –	.09
Pyrogallic, resublimed	lb.	1.50 –	1.60
Sulphuric, 60°, tanks	ton	9.00 –	10.00
Sulphuric, 60°, drums	ton	12.00 –	14.00
Sulphuric, 66°, tanks	ton	14.50 –	15.00
Sulphuric, 66° drums	ton	19.00 –	20.00
Tannic, U.S.P., bbl.	lb.	.65 –	.70
Tannic, tech., bbl.	lb.	.40 –	.45
Tartaric, imp. crys., bbl.	lb.	.30½–	.31
Tartaric, imp., powd., bbl.	lb.	.31 –	.32
Tartaric, domestic, bbl.	lb.	..... –	.32
Tungstic, per lb. of WO	lb.	1.00 –	1.20
Alcohol, butyl, drums	gal.	.18 –	.23
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 –	4.95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	.38 –	.40
Alum, ammonia, lump, bbl.	lb.	.03½–	.03¾
Potash, lump, bbl.	lb.	.03 –	.03½
Chrome, lump, potash, bbl.	lb.	.05 –	.05½
Aluminum sulphate, com., bags 100	lb.	1.50 –	1.65
Iron free bags	lb.	.02½–	.02¾
Aqua ammonia, 26°, drums	lb.	.06½–	.07½
Ammonia, anhydrous, cyl.	lb.	.30 –	.30½
Ammonium carbonate, powd. casks, imported	lb.	.09½–	.10
Ammonium carbonate, powd. domestic, bbl.	lb.	.13 –	.14
Ammonium nitrate, tech., casks	lb.	.10 –	.11
Amyl acetate tech., drums	gal.	2.80 –	3.05
Arsenic, white, powd., bbl.	lb.	.15½–	.16
Arsenic, red, powd., kegs	lb.	.13 –	.13½
Barium carbonate, bbl.	ton	75.00 –	77.00
Barium chloride, bbl.	ton	90.00 –	100.00
Barium dioxide, drums	lb.	.18 –	.18½
Barium nitrate, casks		.08½–	.08¾
Barium sulphate, bbl.	lb.	.04 –	.04½
Blanc fixe, dry, bbl.	lb.	.04 –	.04½
Blanc fixe, pulp, bbl.	ton	45.00 –	55.00
Bleaching powder, f.o.b. wks., drums 100	lb.	2.00 –	2.50
Resale drums 100	lb.	2.50 –	2.75
Borax, bbl.	lb.	.05½–	.05¾
Bromine, cases	lb.	.25 –	.27
Calcium acetate, bags 100	lb.	3.50 –	3.60
Calcium carbide, drums	lb.	.04½–	.04¾
Calcium chloride, fused, drums	ton	22.00 –	23.00
Gran. drums	lb.	.01½–	.01¾
Calcium phosphate, mono, bbl.	lb.	.06½–	.07
Camphor, cases	lb.	.86 –	.88
Carbon bisulphide, drums	lb.	.07 –	.07½
Carbon tetrachloride, drums	lb.	.09½–	.10
Chalk, precip.—domestic, light, bbl.	lb.	.04½–	.04¾
Domestic, heavy, bbl.	lb.	.03½–	.03¾
Imported, light, bbl.	lb.	.04½–	.05
Chlorine, liquid, cylinders	lb.	.06 –	.06½
Chloroform, tech., drums	lb.	.35 –	.38
Cobalt oxide, bbl.	lb.	2.10 –	2.25
Copperas, bulk, f.o.b. wks.	ton	16.50 –	20.00
Copper carbonate, bbl.	lb.	.20 –	.20½
Copper cyanide, drums	lb.	.47 –	.50
Copper sulphate, crys., bbl., 100	lb.	6.00 –	6.25
Cream of tartar, bbl.	lb.	.24 –	.25
Dextrine, corn, bags 100	lb.	3.25 –	3.50
Epsom salt, dom., tech., bbl. 100	lb.	2.10 –	2.25
Epsom salt, imp., tech., bags 100	lb.	1.10 –	1.25
Epsom salt, U.S.P., dom., bbl. 100	lb.	2.50 –	2.75
Ether, U.S.P., drums	lb.	.13 –	.15
Ethyl acetate, com., 85%, drums	gal.	.80 –	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 –	1.00
Formaldehyde, 40%, bbl.	lb.	$0.15½–	$0.16½
Fullers earth, f.o.b. mines	net ton	16.00 –	17.00
Fullers earth—imp., powd.,	net ton	30.00 –	32.00
Fusel oil, ref., drums	gal.	3.55 –	4.05
Fusel oil, crude, drums	gal.	2.30 –	2.40
Glaubers salt, wks., bags 100	lb.	1.20 –	1.40
Glaubers salt, imp., bags 100	lb.	1.00 –	1.25
Glycerine, c.p., drums extra	lb.	.18½–	.19
Glycerine, dynamite, drums	lb.	.17 –	.17½
Iodine, resublimed	lb.	4.40 –	4.50
Iron oxide, red, casks	lb.	.12 –	.18
Lead:			
White, basic cabonate, dry, casks	lb.	.09½–	.10
White, in oil, kegs	lb.	.12 –	.13½
Red, dry, casks	lb.	.11½–	.11¾
Red, in oil, kegs	lb.	.13 –	.14½
Lead acetate, white crys., bbl.	lb.	.13 –	.13½
Lead arsenate, powd., bbl.	lb.	.23 –	.24
Lime-Hydrated, bbl.	per ton	16.80 –	17.00
Lime, Lump, bbl	280 lb.	3.63 –	3.65
Litharge, comm., casks	lb.	.09½–	.10
Lithophone, bbl.	lb.	.06½–	.07
Magnesium carb., tech., bags	lb.	.08 –	.08½
Methanol, 95%, bbl.	gal.	1.23 –	1.25
Methanol, 97%, bbl.	gal.	1.25 –	1.27
Nickel salt, double, bbl.	lb.	.10 –	.10½
Nickel salts, single, bbl.	lb.	.11 –	.11½
Phosgene		.60 –	.75
Phosphorus, red, cases	lb.	.35 –	.40
Phosphorus, yellow, cases	lb.	.30 –	.35
Potassium bichromate, casks	lb.	.09½–	.10
Potassium bromide, gran., bbl.	lb.	.16 –	.23
Potassium carbonate, 80-85%, calcined, casks	lb.	.06 –	.06½
Potassium chlorate, powd.	lb.	.07½–	.08
Potassium cyanide, drums	lb.	.47 –	.80
Potassium hydroxide (caustic potash) drums 100	lb.	7.25 –	7.50
Potassium iodide, cases	lb.	3.50 –	3.60
Potassium nitrate, bbl.	lb.	.06½–	.07
Potassium permanganate, drums	lb.	.17½–	.18
Potassium prussiate, red, casks	lb.	.85 –	.90
Potassium prussiate, yellow, casks	lb.	.38 –	.39
Salammoniac, white, gran., casks, imported	lb.	.06½–	.06¾
Salammoniac, white, gran., bbl., domestic	lb.	.08 –	.08½
Gray, gran., casks	lb.	.08½–	.08¾
Salsoda, bbl. 100	lb.	1.20 –	1.40
Salt cake (bulk)	ton	26.00 –	28.00
Soda ash, light, 58% flat, bags, contract 100	lb.	1.60 –	1.67
Soda ash, light, basis, 48% bags, contract, f.o.b. wks. 100	lb.	1.20 –	1.30
Soda ash, light, 58%, flat, bags, resale 100	lb.	1.75 –	1.80
Soda ash, dense, bags, contract, basis 48% 100	lb.	1.17½–	1.20
Soda ash, dense, in bags, resale 100	lb.	1.85 –	1.90
Soda, caustic, 76%, solid, drums, f.a.s. 100	lb.	3.45 –	3.70
Soda, caustic, 76%, solid, drums, contract 100	lb.	3.35	3.40
Soda, caustic, basis 60% wks., contract 100	lb.	2.50 –	2.60
Soda, caustic, ground and flake, contracts 100	lb.	3.80 –	3.90
Soda, caustic, ground and flake, resale 100	lb.	4.00 –	4.15
Sodium acetate, works, bags	lb.	.06½–	.07½
Sodium bicarbonate, bbl. 100	lb.	1.75 –	1.85
Sodium bichromate, casks	lb.	.07½–	.08
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½–	.04¾
Sodium chlorate, kegs	lb.	.06½–	.07
Sodium chloride long	ton	12.00 –	13.00
Sodium cyanide, cases	lb.	.20 –	.23
Sodium fluoride, bbl.	lb.	.09 –	.10
Sodium hyposulphite, bbl.	lb.	.03 –	.03½
Sodium nitrite, casks	lb.	.08½–	.09
Sodium peroxide, powd., cases	lb.	.28 –	.30
Sodium phosphate, dibasic, bbl.	lb.	.03½–	.04
Sodium prussiate, yel. drums	lb.	.19 –	.19½
Sodium silicate (40°, drums) 100	lb.	.80 –	1.15
Sodium silicate (60°, drums) 100	lb.	2.00 –	2.25
Sodium sulphide, fused, 60-62% drums	lb.	.04 –	.04½
Sodium sulphite, crys., bbl.	lb.	.03½–	.03¾
Strontium nitrate, powd., bbl.	lb.	.09½–	.10½
Sulphur chloride, yel drums	lb.	.04½–	.05
Sulphur, crude	ton	18.00 –	20.00
Sulphur dioxide, liquid, cyl.	lb.	.08 –	.08½
Sulphur, flour, bbl. 100	lb.	2.35 –	3.15
Sulphur, roll, bbl. 100	lb.	$2.00 –	$2.50
Talc—imported, bags	ton	30.00 –	40.00
Talc—domestic powd., bags	ton	18.00 –	25.00
Tin bichloride, bbl.	lb.	.11 –	.11½
Tin oxide, bbl.	lb.	.45 –	.47
Zinc carbonate, bags	lb.	.14 –	.14½
Zinc chloride, gran, bbl.	lb.	.06 –	.07
Zinc cyanide, drums	lb.	.38 –	.40
Zinc oxide, XX, bbl.	lb.	.07½–	.08
Zinc sulphate, bbl. 100	lb.	2.75 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.80 –	$0.85
Alpha-naphthol, ref., bbl.	lb.	1.05 –	1.10
Alpha-naphthylamine, bbl.	lb.	.27 –	.30
Aniline oil, drums	lb.	.16½–	.17
Aniline salts, bbl.	lb.	.24 –	.25
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 –	.70
Anthraquinone, 25%, paste, drums	lb.	.70 –	.75
Benzaldehyde U.S.P., carboys	lb.	1.40 –	1.45
Benzene, pure, water-white, tanks and drums	gal.	.30 –	.35
Benzene, 90%, tanks & drums	gal.	.26 –	.32
Benzene, 90%, drums, resale	gal.	.32 –	.34
Benzidine base, bbl.	lb.	.85 –	.90
Benzidine sulphate, bbl.	lb.	.75 –	.80
Benzoic acid, U.S.P., kegs	lb.	.72 –	.75
Benzoate of soda, U.S.P., bbl.	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 –	.27
Benzyl chloride, tech., drums	lb.	.20 –	.23
Beta-naphthol, subl., bbl.	lb.	.55 –	.60
Beta-naphthol, tech., bbl.	lb.	.25 –	.26
Beta-naphthylamine, tech.	lb.	1.00 –	1.25
Carbazol, bbl.	lb.	.75 –	.90
Cresol, U.S.P., drums	lb.	.25 –	.27
Ortho-cresol, drums	lb.	.24 –	.26
Cresylic acid, 97%, resale, drums	gal.	1.60 –	1.75
95-97%, drums, resale	gal.	1.60 –	1.75
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb.	.40 –	.41
Dinitrobenzene, bbl.	lb.	.20 –	.22
Dinitrocolorbenzene, bbl.	lb.	.22 –	.23
Dinitronaphthalene, bbl.	lb.	.30 –	.32
Dinitrophenol, bbl.	lb.	.35 –	.40
Dinitrotoluene, bbl.	lb.	.22 –	.24
Dip oil, 25%, drums	gal.	.25 –	.30
Diphenylamine, bbl.	lb.	.54 –	.56
H-acid, bbl.	lb.	.75 –	.80
Meta-phenylenediamine, bbl.	lb.	.95 –	1.00
Michlers ketone, bbl.	lb.	3.00 –	3.50
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, crushed, bbl.	lb.	.05½–	.06
Naphthalene, flake, bbl.	lb.	.06 –	.06½
Naphthalene, balls, bbl.	lb.	.07 –	.07½
Naphthionate of soda, bbl.	lb.	.58 –	.65
Naphthionic acid, crude, bbl.	lb.	.60 –	.65
Nitrobenzene, drums	lb.	.10 –	.12
Nitro-naphthalene, bbl.	lb.	.30 –	.35
Nitro-toluene, drums	lb.	.15 –	.17
N-W acid, bbl.	lb.	1.15 –	1.20
Ortho-amidophenol, kegs	lb.	2.30 –	2.35
Ortho-dichlorbenzene, drums	lb.	.17 –	.20
Ortho-nitrophenol, bbl.	lb.	.90 –	.92
Ortho-nitrotoluene, drums	lb.	.10 –	.12
Ortho-toluidine, bbl.	lb.	.13 –	.15
Para-amidophenol, base, kegs	lb.	1.15 –	1.20
Para-amidophenol, HCl, kegs	lb.	1.20 –	1.25
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitraniline, bbl.	lb.	.73 –	.75
Para-nitrotoluene, bbl.	lb.	.55 –	.65
Para-phenylenediamine, bbl.	lb.	1.50 –	1.55
Para-toluidine, bbl.	lb.	.85 –	.90
Phthalic anhydride, bbl.	lb.	.35 –	.38
Phenol, U.S.P., drums	lb.	.35 –	.37
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom., drums	gal.	nominal	
Pyridine, imp., drums	gal.	3.00 –	3.10
Resorcinol, tech., kegs	lb.	1.50 –	1.55
Resorcinol, pure, kegs	lb.	2.00 –	2.10
R-salt, bbl.	lb.	.55 –	.60
Salicylic acid, tech., bbl.	lb.	.40 –	.42
Salicylic acid, U.S.P., bbl.	lb.	.45 –	.47
Solvent naphtha, water-white, drums	gal.	.37 –	.40
Crude, drums	gal.	.22 –	.24
Sulphanilic acid, crude, bbl.	lb.	.18 –	.20
Thiocarbanilide, kegs	lb.	.35 –	.38
Toluidine, kegs	lb.	1.20 –	1.30
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars	gal.	.35 –	.37
Toluene, drums	gal.	.40 –	.43
Xylidines drums	lb.	.40 –	.45
Xylene, pure, drums	gal.	.45 –	.50
Xylene, com., drums	gal.	.40 –	.42
Xylene, com., tanks	gal.	.30 –	.....

Naval Stores

Rosin B-D, bbl.	280 lb.	$5.75 –	
Rosin E-I, bbl.	280 lb.	5.90 –	
Rosin K-N, bbl.	280 lb.	6.10 –	$6.35
Rosin W.G.-W.W., bbl.	280 lb.	7.75 –	8.25
Wood rosin, bbl.	280 lb.	6.25 –	
Turpentine, spirits of, bbl.	gal.	1.41 –	1.42
Wood, steam dist., bbl.	gal.	1.35 –	
Wood, dest. dist., bbl.	gal.	1.25 –	
Pine tar pitch, bbl.	200 lb.	–	6.00
Tar, kiln burned, bbl.	500 lb.	–	12.00
Retort tar, bbl.	500 lb.	–	11.00
Rosin oil, first run, bbl.	gal.	.43 –	
Rosin oil, second run, bbl.	gal.	.47 –	
Rosin oil, third run, bbl.	gal.	.53 –	
Pine oil, steam dist.	gal.	–	.90
Pine oil, pure, dest. dist.	gal.	–	.85
Pine tar oil, ref.	gal.	–	.46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	–	.35
Pine tar oil, double ref., bbl.	gal.	–	.75
Pine tar, ref., thin, bbl.	gal.	–	.25
Pinewood creosote, ref., bbl.	gal.	–	.52

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$.12½–	$.12½
Castor oil, AA, bbl.	lb.	.12½–	.13
Chinawood oil, bbl.	lb.	.18 –	.18½
Coconut oil, Ceylon, bbl.	lb.	.09½–	.9½
Coconut oil, Cochin, bbl.	lb.	.09½–	.10
Corn oil, crude, bbl.	lb.	.11½–	.11½
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½–	.10
Summer yellow, bbl.	lb.	.12½–	.12½
Winter yellow, bbl.	lb.	.13 –	.13½
Linseed oil, raw, car lots, bbl.	gal.	.96 –	.97
Raw, tank cars (dom.)	gal.	.92 –	.93
Boiled, 5-bbl. lots (dom.)	gal.	1.00 –	1.02
Olive oil, denatured, bbl.	gal.	1.00 –	1.15
Palm, Lagos, casks	lb.	.08 –	.08½
Palm kernel, bbl.	lb.	.08½–	.09
Peanut oil, crude, tanks (mill)	lb.	.13½–	.13½
Peanut oil, refined, bbl.	lb.	.16 –	.16½
Rapeseed oil, refined, bbl.	gal.	.85 –	.86
Rapeseed oil, blown, bbl.	gal.	.90 –	.91
Soya bean (Manchurian), bbl.	lb.	.11½–	
Tank, f.o.b. Pacific coast	lb.	.10 –	

Fish Oils

Menhaden, light pressed, bbl.	gal.	$0.60 –	
White bleached, bbl.	gal.	.64 –	.65
Blown, bbl.	gal.	.68 –	.69
Whale No. 1 crude, tanks, coast	lb.	.06 –	.06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38.00 –	$39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Logwood, sticks	ton	28.00 –	30.00
Logwood, chips, bags	lb.	.02½–	.03½
Sumac, leaves, Sicily, bags	ton	65.00 –	
Sumac, ground, bags	ton	55.00 –	60.00
Sumac, domestic, bags	ton	35.00 –	
Tapioca flour, bags	lb.	.03½–	.05
EXTRACTS			
Archil, conc., bbl.	lb.	$0.17 –	$0.18
Chestnut, 25% tannin, tanks	lb.	.02 –	.03
Divi-divi, 25% tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.08 –	.09
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.04 –	.05
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.14 –	.17
Logwood, crys., bbl.	lb.	.19 –	.20
Logwood, liq., 51°, bbl.	lb.	.09 –	.10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½–	.05
Sumac, dom., 51°, bbl.	lb.	.06½–	.07

Waxes

Bayberry, bbl.	lb.	$0.28 –	$0.30
Beeswax, refined, dark, bags	lb.	.30 –	.32
Beeswax, refined, light, bags	lb.	.34 –	.35
Beeswax, pure white, cases	lb.	.40 –	.41
Candellila, bags	lb.	.34 –	.35
Carnauba, No. 1, bags	lb.	.38 –	.40
No. 2, North Country, bags	lb.	.24 –	.24½
No. 3, North Country, bags	lb.	.17½–	.18½
Japan, cases	lb.	.15 –	.15½
Montan, crude, bags	lb.	.03½–	.04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 –	.04½
Crude, scale 124-126 m.p., bags	lb.	.02½–	.02¾
Ref., 118-120 m.p., bags	lb.	.03½–	.03¾
Ref., 125 m.p., bags	lb.	.03½–	.03¾
Ref., 128-130 m.p., bags	lb.	.04 –	.04½
Ref., 133-135 m.p., bags	lb.	.04½–	.04½
Ref., 135-137 m.p., bags	lb.	.05 –	.05½
Stearic acid, sgle pressed, bags	lb.	.10 –	.10½
Double pressed, bags	lb.	.10½–	.10½
Triple pressed, bags	lb.	.11 –	.11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 –	$3.25
F.a.s. double bags	100 lb.	3.85 –	3.95
Blood, dried, bulk	unit	4.60 –	
Bone, raw, 3 and 50, ground	ton	30.00 –	35.00
Fish scrap, dom., dried, wks.	unit	5.00 –	5.10
Nitrate of soda, bags	100 lb.	2.60 –	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.70 –	4.80
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 –	$4.00
Tennessee, 78-80%	ton	7.00 –	8.00
Potassium muriate, 80%, bags	ton	35.00 –	36.00
Potassium sulphate, bags	unit	1.00 –	

Crude Rubber

Para—Upriver fine	lb.	$0.33½–	$0.34
Upriver coarse	lb.	.27½–	.28
Upriver caucho ball	lb.	.29 –	.29½
Plantation—First latex crepe	lb.	.35½–	.35½
Ribbed smoked sheets	lb.	.35½–	.35½
Brown crepe, thin, clean	lb.	.31 –	.32
Amber crepe No. 1	lb.	.31 –	.32

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450.00 –	$550.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	60.00 –	80.00
Asbestos, cement, f.o.b., Quebec	sh. ton	15.00 –	17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 –	20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 –	21.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	24.00 –	28.00
Barytes, crude f.o.b. mines, bulk	net ton	8.50 –	9.00
Casein, bbl., tech.	lb.	.11 –	.12
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 –	9.00
Washed, f.o.b. Ga.	net ton	8.00 –	9.00
Powd., f.o.b. Ga.	net ton	13.00 –	20.00
Crude f.o.b. Va.	net ton	8.00 –	12.00
Ground, f.o.b. Va.	net ton	13.00 –	20.00
Imp., lump, bulk	net ton	15.00 –	20.00
Imp., powd.	net ton	45.00 –	50.00
Feldspar, No. 1 pottery	long ton	6.00 –	7.00
No. 2 pottery	long ton	5.00 –	5.50
No. 1 soap	long ton	7.00 –	7.50
No. 1 Canadian, f.o.b. mill	long ton	25.00 –	27.00
Graphite, Ceylon, lump, first quality, bbl.	lb.	.06 –	.06½
Ceylon, chip, bbl.	lb.	.05 –	.05½
High grade amorphous crude	ton	35.00 –	50.00
Gum arabic, amber, sorts, bags	lb.	.15 –	.16
Gum tragacanth, sorts, bags	lb.	.50 –	.60
No. 1, bags	lb.	1.75 –	1.80
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N. Y.	ton	50.00 –	55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 –	15.00
Pumice stone, imp., casks	lb.	.03 –	.05½
Dom., lump, bbl.	lb.	.05 –	.05½
Dom., ground, bbl.	lb.	.06 –	.07
Shellac, orange fine, bags	lb.	.83 –	.84
Orange superfine, bags	lb.	.85 –	.86
A. C. garnet, bags	lb.	.80 –	.81
T. N., bags	lb.	.81 –	.82
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50	5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 –	17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 –	2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 –	9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 –	9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 –	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N. Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11½	.11¾
4-6% C	lb.	.12 –	.13
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	105.00 –	107.50
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb Mo	lb.	1.90 –	2.15
Ferrosilicon, 10-15%	gr. ton	38.00 –	40.00
50%	gr. ton	80.00 –	85.00
75%	gr. ton	150.00 –	160.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U. per lb. of U	lb.	6.00 –	
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.50 –	$8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 –	23.00
C.i.f. Atlantic seaboard	ton	18.50 –	19.00
Coke, fdry., f.o.b. ovens	ton	9.25 –	9.50
Coke, furnace, f.o.b. ovens	ton	8.00 –	8.50
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17.50 –	
Fluorspar, No. 2 Lump — Ky. & Ill. mines	ton	25.00 –	
Ilmenite, 52% TiO_2	lb.	.01½–	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.33 –	
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.65 –	.70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 –	.08
Pyrites, Span., fines, c.i.f. Atl seaport	unit	.11½–	.12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½–	.12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12	
Rutile, 95% TiO_2	lb.	.12 –	
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 –	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2.25 –	2.50
Vanadium pentoxide, 99%	lb.	12.00 –	14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 –	
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½–	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	15.00
Aluminum, 98 to 99%	23.00
Antimony, wholesale, Chinese and Japanese	7.15–7.50
Nickel, virgin metal	25.00–27.00
Nickel, ingot and shot	29.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	38.00
Monel metal, sheet bars	45.00
Tin, 5-ton lots, Straits	40.50
Lead, New York, spot	8.00
Lead, E. St. Louis, spot	8.00–8.125
Zinc, spot, New York	7.25–7.30
Zinc, spot, E. St. Louis	6.85–7.05

OTHER METALS

Silver (commercial)	oz.	$0.64
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.55
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz.	114.00@116.00
Iridium	oz.	250.00@275.00
Palladium	oz.	65.00@ 70.00
Mercury	75 lb.	71.50

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.75
Copper bottoms	30.75
Copper rods	20.50
High brass wire	19.50
High brass rods	17.00
Low brass wire	21.10
Low brass rods	22.00
Brazed brass tubing	24.25
Brazed bronze tubing	29.00
Seamless copper tubing	25.25
Seamless high brass tubing	23.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.30@11.50
Copper, heavy and wire	11.25@11.50
Copper, light and bottoms	9.25@ 9.50
Lead, heavy	5.75@ 6.00
Lead, tea	3.50@ 3.75
Brass, heavy	6.25@ 6.40
Brass, light	5.35@ 5.75
No. 1 yellow brass turnings	6.30@ 6.50
Zinc	3.50@ 4.00

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.29	$3.14
Soft steel bars	3.19	3.04
Soft steel bar shapes	3.19	3.04
Soft steel bands	3.29	3.19
Plates, ¼ to 1 in. thick	3.29	3.1½

Industrial

Financial. Construction and Manufacturers' News

Construction and Operation

Alabama

TALLADEGA — The Talladega Pipe Co., manufacturer of cast-iron pipe, will make extensions and improvements in its foundry for considerable increase in capacity. E. O. Norman is plant superintendent.

CALERA — The O'Neals Lime Works, Eureka, Ala., has plans in progress for the construction of a new plant in the vicinity of Calera for the manufacture of hydrated lime, with department for the production of agricultural lime. It will consist of 10 kilns and complete operating facilities and labor-saving machinery for an annual production of 1,000,000 bbl. The majority of the equipment will be electrically operated. The new works is estimated to cost $500,000. The Schaffer Engineering & Equipment Co., 2818 Smallman St., Pittsburgh, Pa., is preparing plans. The company has recently removed its general offices from Birmingham to the present plant at Eureka. John H. Adams is president.

ANNISTON—The Independent Soil Pipe Co., recently formed with a capital of $75,000, to manufacture cast-iron pipe, has acquired the local plant of the Ajax Foundry Co., and will operate at this location. Extensions and improvements are planned in the present works. R. B. Carr is secretary, and R. T. House, general manager.

Arkansas

BERRYVILLE—H. H. Beal is organizing a company to construct and operate a local plant for the manufacture of lime products. Work will be placed under way at an early date.

ARKADELPHIA—The Arkadelphia Milling Co. is planning for the erection of a number of new buildings at its plant for the production of molasses and affiliated products. W. N. Adams is general manager.

Arizona

DOUGLAS—The Calumet & Arizona Mining Co., Calumet, Mich., has arranged an appropriation of $500,000 for extensions and improvements in its smelting plant at Douglas, including the installation of a new crushing, sampling and ore-treating plant. It is expected to commence construction at an early date and complete the installation in the fall.

California

EMERYVILLE—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and First National Bank Bldg., San Francisco, has awarded a contract to the Ralph McLeran Co., Hearst Bldg., for the erection of the first unit of a new plant at Green and 62nd Sts., Emeryville, to be 1- and 2-story, estimated to cost close to $200,000, with equipment. It will be operated by the Westinghouse High Voltage Insulator Co., a subsidiary organized, and used exclusively for porcelain insulator manufacture. Four oil-burning kilns will be installed, and this battery will ultimately be increased to 12 such kilns. California clays will be utilized for the manufacture. Ray P. Jackson, formerly located at the East Pittsburgh works, will be general manager at the plant.

HUNTINGTON BEACH—The Pacific Gasoline Co. is planning for the installation of a large gasoline-absorption plant on local site, estimated to cost close to $100,000. Headquarters of the company are at Los Angeles; W. J. Bower is president and general manager. E. T. Hitchcock will be in charge of construction.

LOS ANGELES—The American Agar Co., San Diego, operating a local plant for the manufacture of gelatin from seaweed, has been granted permission by the Board of Harbor Commissinooners to construct and operate a similar plant on site selected at Fish Harbor, San Pedro. It is estimated to cost close to $200,000, with machinery. A present experimental plant at Glendale, Calif., will be removed to the new location. Dr. C. F. Farrow is president.

PASADENA—The Art Concrete Works, 364 South Fair Oaks Ave., has plans under way for the erection of a 1-story addition to its cement composition plant, 36x80 ft.

SAN JOSE—The Pacific Gas & Electric Co., 445 Sutter St., San Francisco, will install a new artificial gas-generating plant on local site, estimated to cost approximately $100,000.

Colorado

DENVER—The Midwest Refining Co., First National Bank Bldg., will commence the immediate erection of a third unit at its gasoline-refining plant in the Salt Creek field, to increase the capacity to about 100,000 gal. per day.

Connecticut

HARTFORD—The Hartford Rubber Works, a subsidiary of the United States Rubber Corp., is planning for the rebuilding of the portion of its plant, destroyed by fire, Feb. 3. The bulk of the loss was confined to the machinery.

Georgia

CEDARTOWN—The T. J. Rice Co., LaGrange, Ga., operating a local iron foundry, is planning for the immediate establishment of a new plant at Cedartown. It is proposed to continue the present plant at LaGrange.

Idaho

GLENNS FERRY—The American Mining & Development Co. is perfecting plans for the installation of a new milling plant at its local properties. Charles Alban is president.

Illinois

CHICAGO—The Goldsmith Brothers Smelting & Refining Co., 5844 Throop Ave., has commenced the erection of its proposed new plant additions, to consist of a 1-story structure, 15x135 ft., at Throop Ave. and 58th St., to be used for the production of copper sulphate, and a similar 1-story building at Ada and 59th Sts., to be equipped as a smelting plant. The expansion will cost about $200,000, including machinery.

GRANITE CITY—The Union Starch & Refining Co. is completing plans for the construction of a new 1-story addition, 40x75 ft., to cost about $15,000. J. E. Irwin is secretary.

CHICAGO—The Lake View Brick Co., 2758 Irving Park Blvd., has purchased property at Irving Park Blvd. and California Ave., 666x1320 ft., for a consideration of $45,000, to be used for an addition to its plant.

CHICAGO—The Northwestern Foundry Co., 662 West Roosevelt Rd., has awarded a contract to William F. Solomon & Co., 175 West Jackson Blvd., for the rebuilding of a 1-story foundry at its plant, 50x126 ft., recently partly destroyed by fire. The company manufactures grey iron castings.

CHICAGO—The Chicago Extruded Metals Co., recently organized, has commenced the construction of a new plant on 54th Ave., near 19th St., Cicero, for the manufacture of brass products. It is estimated to cost in excess of $200,000, with machinery.

Indiana

WARSAW—The Interstate Public Service Co., Board of Trade Bldg., Indianapolis, has plans in preparation for the installation of a new filtration plant at Center Lake, Warsaw, for the local water system, estimated to cost $75,000.

FORT WAYNE—The Dudlo Mfg. Co., Wall St., manufacturer of electric wire products, is said to be planning for the immediate rebuilding of the portion of its enameling department, destroyed by fire, Jan. 29, with loss approximating $10,000.

SHELBYVILLE—Fire, Jan. 30, destroyed the local plant of the Kennedy Car Liner & Bag Co., manufacturer of paper products, with loss estimated at $200,000, including machinery. A temporary plant will be established pending the rebuilding of the works. The company maintains a branch at Greensburg, Ind. Fred W. Kennedy is president.

Kentucky

BOWLING GREEN—The Central Producing & Refining Co. has acquired property in Warren and Allen Counties, and has preliminary plans under consideration for the erection of a new oil-refining plant.

MARION—The Big Four Fluorspar & Ore Co., 903 Farmers' Bank Bldg., Pittsburgh, Pa., is perfecting plans for the erection of a new mining and milling plant on site near Marion, comprising a number of 1-story buildings, estimated to cost close to $100,000, including machinery. W. J. Strassburger is president.

Louisiana

NAPOLEONVILLE—The local refinery of the Oakley Sugar Co. has been acquired by new interests, headed by Geoffrey Barton and C. C. Percy. A company will be organized to operate the plant, and a number of extensions and improvements made.

Maryland

BALTIMORE — The Prudential Oil Corp., Fairfield, has filed plans for the erection of an addition to its local oil storage and distributing plant, 40x120 ft., estimated to cost $100,000. Four steel tanks will be installed.

Massachusetts

MALDEN — The Malden & Melrose Gas Light Co. will soon commence the erection of an addition to its artificial gas plant to double the present capacity. The retorts will be designed for automatic coal-feeding. The expansion is estimated to cost close to $400,000, including equipment.

SPRINGFIELD—The Springfield Gas Light Co. has tentative plans under consideration for the rebuilding of the portion of its artificial-gas plant, destroyed by fire, caused by an explosion, Feb. 1, with loss estimated in excess of $300,000, including equipment. It is said that new plant will be established in another location.

Michigan

MANISTIQUE — The Manistique Brass & Bronze Co., recently established to manufacture a line of brass and bronze products, is arranging for the immediate erection of a new 1-story addition.

IRON MOUNTAIN—The Ford Motor Co., Highland Park, is planning for the erection of a large chemical plant in this vicinity, to be used in connection with its iron ore and blast-furnace properties. It is estimated to cost in excess of $750,000, with machinery.

JACKSON — Dr. D. Robinson, 408 South Jackson St., is taking bids through Architect H. Graf, Chamber of Commerce Bldg., for the erection of a 2-story and basement chemical laboratory on West Main St., 56x75 ft., estimated to cost $50,000.

WHITE PIGEON — The Eddy Paper Co., Three Rivers, Mich., will abandon plans temporarily for the proposed extensions and improvements at its local mills, used for carton production, estimated to cost close to $400,000. The plant will be utilized for other purposes, and a new 1-story building erected.

Minnesota

HIBBING—The Oliver Iron Mining Co., Duluth, is perfecting plans for the construction of a new crushing and screening plant, 89x105 ft., at its Hull Rust mining properties, estimated to cost close to $100,000. F. R. Mott is general superintendent.

Mississippi

GULFPORT—The Gulf Coast Refining Co. will take bids at once for the installation of additional equipment at its crude oil works, in connection with proposed extensions, estimated to cost about $35,000.

New Hampshire

NEWINGTON—Fire, Jan. 23, destroyed the chemical laboratory at the local plant of the Atlantic Dyestuff Co., Ames Bldg., Boston, Mass., with loss estimated at $25,000. It is planned to rebuild.

New Jersey

ELIZABETH—The Stanwood Rubber Co., Newark Ave., operating a local plant for the manufacture of automobile tires, recently reorganized, will install additional machinery for the manufacture of cord tires. The works have been idle for about a year and were acquired from the receiver. S. P. Woodard has been elected president of the new company and Charles K. Cooper assistant treasurer. C. O. Corey is superintendent.

ELIZABETH—The Standard Oil Co. of New Jersey, 26 Broadway, New York, has plans under way for the erection of an addition to its local Bayway refinery, 125x200 ft., to be used as a paraffin plant. It is estimated to cost close to $500,000, including machinery.

NEWARK—K. Kaufmann & Co., 169 Murray St., manufacturers of leather goods, are taking bids on a general contract for the erection of a 3-story addition, 65x100 ft., to cost about $35,000. William E. Lehman, 738 Broad St., is architect.

NIXON (New Brunswick)—Fire, Jan. 26, destroyed the vaporization department at the plant of the Nixon Nitration Co., which has been used for some time past for the production of celluloid products. An estimate of loss has not been made. It is planned to rebuild.

New York

SYRACUSE—Plans are being perfected for the organization of a new company to be known as the Syra-Cord Rubber Co., to take over and operate the local plant of the Syracuse Rubber Co. The new company will be capitalized at $1,000,000, and purposes to make extensions and improvements in the existing works. Production will be devoted to cord tires and kindred rubber products.

WATER VALLEY—The Water Valley Foundry Co. has tentative plans under consideration for the rebuilding of its foundry, destroyed by fire, Jan. 25.

North Carolina

STATESVILLE—The C. H. Turner Foundry Co., Inc., recently organized with a capital of $100,000, will commence the immediate erection of a new 1-story foundry, 75x135 ft., for the manufacture of iron castings. It will be equipped for an initial daily production of about 6 tons. C. H. Turner is president, and D. C. Ritchie, secretary and treasurer.

Ohio

ZANESVILLE—The Columbia Chemical Division of the Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Pa., is taking bids on a general contract for the erection of its proposed new plant at White Cottage, near Zanesville, estimated to cost about $1,500,000, including machinery. A total of eleven 1- and 2-story buildings will be constructed. F. A. Jones, Monumental Bldg., Zanesville, is engineer and local manager.

AKRON—Plans are being completed for the construction of a municipal plant for the production of alum for use at the city waterworks, estimated to cost about $15,000. W. F. Peters, city service director, is in charge.

Pennsylvania

WHITE HAVEN—The Peerless Powder Co. has construction under way on new plant buildings and plans to have the structures ready for the equipment at an early date.

GLENSIDE—The Gulf Refining Co., Frick Annex, Pittsburgh, has plans nearing completion for the erection of a 2-story oil storage and distributing plant at Glenside, estimated to cost $50,000.

CREIGHTON—The Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, has acquired the foundry and shops of Yost Brothers, on site adjoining its Creighton works, known as the No. 1 Plant, to be used for proposed extensions.

Tennessee

CHATTANOOGA—The Tennessee Furniture Corp. is planning for the erection of a new building for enameling and porcelain work, in connection with other plant additions to cost about $165,000.

Texas

TEXAS CITY—The Texas Sugar Refining Co. has plans in progress for the erection of a new local refinery, estimated to cost in excess of $100,000, including machinery. It is purposed to have the mill ready for service early in the fall.

PORT ARTHUR—The Gulf Refining Co. has commenced the construction of a new oil plant on local site, to comprise a catalytic distillation unit of 32 stills and auxiliary equipment, re-run plant and other structures, estimated to cost in excess of $250,000, complete.

YOAKUM—The Texas Hide & Leather Co. has work in progress on extensions and improvements in its tannery for extensive increase in production. Plans are also being perfected for the erection of an addition to the sole leather department, for which a list of equipment to be installed will soon be arranged.

Virginia

ROANOKE—The Roanoke Tire & Rubber Co. is perfecting plans for the erection of a new 3-story plant for the manufacture of cord tires for automobile service and other rubber products. Charles H. Kieffer is assistant secretary and general manager.

Washington

OLYMPIA—The West Coast Pulp & Paper Co., recently organized as a subsidiary of the Hawley Pulp & Paper Co., Oregon City, Ore., is perfecting plans and will soon commence the erection of a new local mill, to consist of a paper manufacturing plant, sulphide mill and auxiliary structures, estimated to cost in excess of $500,000, with machinery.

West Virginia

CLARKSBURG—The Liberty Glass Co., manufacturer of window glass, is planning for extensions in its plant, including the remodeling of the present plant from hand to machine operated. Considerable additional machinery will be installed. Hugh Smith, an official of the company, is in charge of purchases.

Industrial Developments

PAPER—The Grass Fiber Pulp & Paper Corp., Leesburg, Fla., has commenced operations at its new pulp mill, recently completed, and expects to begin the production of paper in the other plant departments at an early date. The plant will be devoted to the manufacture of paper from saw grass.

Paper mills in the Michigan district are advancing production and adding to their working forces.

The American Writing Paper Co., Holyoke, Mass., is maintaining regular operations at its different mills in this section, giving employment to normal working forces.

GLASS—The Baker Brothers Glass Co., Okmulgee, Okla., manufacturer of window glass, has resumed operations at its plant at Sapulpa, Okla., and will develop capacity production. The Okmulgee works has been closed and the skilled employees have moved to the Sapulpa plant. Repairs and improvements will be made to the machinery at the idle plant during the coming weeks, and it is planned to reopen late in the spring. It is expected to resume production at the Augusta, Kan., factory at an early date, following a shut-down for some time past.

The Millville Bottle Works, Millville, N. J., has resumed service at one of its large glass tanks, recently closed down through failure of the furnace. Production will be advanced at the plant.

Glass plants in western Pennsylvania are running full, giving employment to regular working forces. Night shifts have been scheduled at a number of the factories.

LEATHER—The American Hide & Leather Co., New York, N. Y., has advanced production at its different tanneries, and is now running at close to normal. It is said that heavy incoming orders insure full capacity for some time to come.

Glazed kid plants at Camden, N. J., and Wilmington, Del., are operating at a prewar basis, giving employment to regular working forces. It is expected that increasing orders now being received will advance production to maximum at an early date at the majority of the tanneries.

Burk Brothers, 923 North 3rd St., Philadelphia, Pa., manufacturers of glazed kid, are operating their tannery at about 75 per cent of normal. An early increase is expected.

V. & F. W. Filoon Co., Brockton, Mass., manufacturer of sole leather, is running full in all departments. Maximum output is being developed in the welting division.

Gensemer & Salem, operating two tanneries at Pine Grove, Pa., are maintaining full production at both plants, giving employment to regular working forces. No contract tanning is being handled at the present time.

CERAMIC — The Burton-Townsend Co., Zanesville, O., manufacturer of brick, is planning for an early increase in production and has extensions and improvements in progress for this purpose. The advance will average from 25 to 30 per cent. R. C. Burton, one of the heads of the company, is also planning for the construction of a new plant in this vicinity.

Potteries in East Liverpool, O., report increasing business and the majority of the general ware plants are now running on a full basis, with full working forces.

Brick-manufacturing plants in Georgia are operating at full capacity and expect to maintain this schedule for an indefinite period.

The Niloak Pottery Co., Benton, Ark., manufacturer of art and novelty ware, is maintaining full operations at its plant and plans for the early erection of a number of new kilns for increased manufacture. The working force will be enlarged.

Brick plants at Philadelphia, Pa., equipped with mechanical drying systems, are maintaining capacity production, with full working forces. About 25 per cent of the local plants, arranged for seasonal operation only, are closed down.

The Best Brick Co., Evansville Ind., is running at full capacity and will maintain this schedule for an indefinite period. The company recently received an order for 500,000 face brick for the new works of the Ford Motor Co., at Chicago, Ill.

IRON AND STEEL—The Bethlehem Steel Corp. is arranging for the early blowing in of another blast furnace at its Steelton, Pa., works. Repairs are in progress at furnace E at the mills, and it is expected to have this unit ready for service at an early date. Other departments of the works will also advance operations at an early date.

The Thropp blast furnace at Earlston, near Bedford, Pa., has completed relining and other repairs, and plans are under way to blow in at an early date. The company's coke ovens in the Broad Top section will also be placed on the active list at the same time.

The Sloss-Sheffield Steel Co., Birmingham, Ala., will continue the employment of convict labor at its mills as a result of a bill signed by Governor Brandon, deferring any change in the present convict leasing system until March, 1927. The plant is continuing production at full capacity.

The Harrow Spring Co., Kalamazoo, Mich., is maintaining production at its two rolling mills and electric furnace, giving employment to a regular working force. The local plant will be included in the recent merger of the Steel & Tube Co. of America, Chicago, Ill., and the Youngstown Sheet & Tube Co., Youngstown, O.

The Reading Iron Co., Reading, Pa., has placed its universal mill on 9th St. in operation, after a shut-down since last November. The mill will give employment to about 100 men on single turn.

In the Sharon, Pa., district, the Carnegie Steel Co. has all departments of its mills running full with the exception of the by-product coke ovens, which have been idle for about 24 months. The American Sheet & Tin Plate Co. is operating at full capacity at its hot mills, while the American Steel & Wire Co. has a schedule of approximately 75 per cent of capacity. The Sharon Steel Hoop Co. is in active service at all of its local finishing mills, with the Youngstown, O., plant running at normal capacity. Six of 14 blast furnaces are on the active list, 3 of these being those of the Carnegie Company, 2 the Shenango Furnace Co. and 1 of the Reliance Coke & Furnace Co., at Sharpsville.

The Witherbee, Sherman Co., New York, has postponed the blowing in of its blast furnace at Port Henry, N. Y., scheduled for Feb. 1, owing to coke shortage. It is expected to apply the torch before the close of the month if coke now in transit is received at the plant. The plant has been idle for about 12 months, during which time a number of improvements and extensions have been made. The furnace operates on magnetic ore and has a rated production of 250 tons of pig iron per day. A new blast furnace is now in course of construction at the plant, to have an output of 500 tons per day; this unit is scheduled for blowing in during April.

The Carnegie Steel Co. has active construction under way on an addition to its byproduct plant at Clairton, Pa. The present plant, said to be the largest of its kind in the world, consists of 640 ovens, arranged in 10 batteries of 64 each. The extension will provide for 366 new byproduct coke ovens, a benzol motor fuel recovery plant and a byproducts plant.

MISCELLANEOUS—The Kansas City Malleable Castings Co., Kansas City, Mo., has resumed production at its plant after a shut-down of more than 18 months. The Dayton Malleable Iron Co., Dayton, O., is interested in the company.

Graphite mines in the vicinity of Burnet, Tex., are now producing at the rate of about 16,000 tons of ore per day.

Rubber mills at Akron, O., are operating on a basis of 85 per cent of capacity, including tires and other rubber products.

New Companies

THE CHLORIDE PRODUCTS, INC., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture sodium, potash, magnesium and affiliated products.

THE STERLITE FOUNDRY & MFG. CO., Auburn, Ind., has been incorporated with a capital of $75,000, to manufacture special metals, metal castings, etc. The incorporators are J. A. Rendel, R. J. Schweitzer and A. L. Kuhlman, all of Auburn.

THE FRANK SHINN CO., INC., Philadelphia, Pa., is being organized under state laws to manufacture paints, varnishes, colors, etc. Application for a state charter will be made on Feb. 19. The company is represented by John E. Gensemer, Crozer Bldg., Philadelphia.

THE SANDY RIVER OIL CO., Ashland, Ky., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are Harry L. Claiborne and R. D. Davis, Ashland. The last noted represents the company.

VINCENT & CO., INC., 400 North Michigan Ave., Chicago, Ill., has been incorporated with a capital of $25,000, to manufacture cleaning fluids, compounds, etc. The incorporators are John A. Vincent, Chauncey Blair and Leonard M. Prince.

THE STANDARD SMELTING & REFINING CO., 819 Jersey Ave., Jersey City, N. J., has filed notice of organization to operate a metal smelting and refining works. Harry M. Cohan, 24 East 42nd St., Bayonne, N. J., heads the company.

THE STARK GLASS CO., Massillon, O., has been incorporated with a capital of $30,000, to manufacture glass products. The incorporators are John A. Vincent, Chauncey Ford, both of Massillon.

CHARLES S. WOOD & CO., East Orange, N. J., care of the New Jersey Registration & Trust Co., 525 Main St., East Orange, representative, has been incorporated with a capital of $125,000 to manufacture asbestos products. The incorporators are Charles O. Geyer and associates.

THE NEWMAN-KOHN PAPER CO., Newark, N. J., has been incorporated with a capital of $100,000, to manufacture paper products. The incorporators are Albert Newman, Leon A. and Sylvan H. Cohn, 790 Broad St., Newark. The last noted represents the company.

THE BETWK CORP., New York, N. Y., care of I. L. Dreeben, 50 Broad St., New York, representative, has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts, dyestuffs, etc. The incorporators are J. B. Bateman and S. D. Cowl.

THE BEAR STATE OIL CO., Jefferson City, Mo., has been incorporated under state laws to manufacture petroleum products. The incorporators are R. H. Muzzy, H. C. Weible and G. W. Foland, all of Jefferson City.

THE MELLINGER TIRE & RUBBER CO., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $600,000, to manufacture tires and other rubber goods.

THE HOLMESBURG CONCRETE CO., Philadelphia, Pa., has been incorporated with a capital of $30,000, to manufacture cement and concrete products. B. F. Zimmerman, 7660 Frankford Ave., is treasurer and representative.

THE CUMBERLAND CARBON CO., Charleston, W. Va., has been incorporated under state laws to manufacture carbon products. The incorporators are Roswell T. Hapwood, George E. Thomas and Oscar Nelson, all of Charleston.

THE FRAZIER DRAIN TILE CO., Bluffton, Ind., has been incorporated with a capital of $75,000, to manufacture clay tile, blocks and kindred products. The incorporators are Luther M. Frazier and W. Hobart Frazier, both of Bluffton.

THE NEWBURGH LIME MFG. CO., Newburgh, N. Y., care of J. V. McKee, 51 Chambers St., New York, N. Y., representative, has been incorporated with a capital of $20,000, to manufacture lime products. The incorporators are W. C. Martin, M. Gorchoff and A. Lecheman, Newburgh.

THE MOUNT VERNON LEATHER CO., INC., Philadelphia, Pa., has been incorporated with a capital of $36,000, to manufacture leather products. Harvey Freeman, 2131 North 19th St., Philadelphia, is treasurer and representative.

THE ASBURY STEEL PRODUCTS CO., Indianapolis, Ind., has been incorporated with a capital of $100,000, to manufacture steel specialties. The incorporators are Jerry A. Gallivan, Edward E. Asbury and Everett A. Marcy, all of Indianapolis.

THE MASTER GASOLINE CORP., Oklahoma City, Okla., has been incorporated with a capital of $250,000, to operate a gasoline extraction plant, manufacture refined oils, etc. The incorporators are Benjamin H. Mason, C. B. Kendrick and J. E. Crowder, all of Oklahoma City.

H. LOOS & CO., 409 Ogden St., Jersey City, N. J., have filed notice of organization to manufacture grindstones and other abrasive products. Herman Loos heads the company.

THE GENESEE FELDSPAR CO., Rochester, N. Y., care of William Armstrong, Powers Bldg., Rochester, representative, has been incorporated with a capital of $100,000, to operate a feldspar mill for commercial production. The incorporators are S. R. Parry, W. C. Fredericks and G. E. Worth, Rochester.

THE GLEASONITE PRODUCTS CO., Boston, Mass., care of Edmund S. Hellings, Equitable Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $1,000,000, to manufacture synthetic rubber products, etc. The incorporators are Charles Peters, Louis and Max Brown, Boston.

THE MASON CITY BRICK & TILE CO., Mason City, Iowa, care of the Corporation Trust Co. of America, du Pont Building, Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $3,000,000, to manufacture brick, tile and kindred burned clay products.

THE FANDANGO MILLS, INC., Millburn, N. J., has been incorporated with a capital of $125,000, to manufacture paper and binder board products. The incorporators are M. C. Durr, Frank C. Trubee and George J. Berstler, Millburn. The last noted represents the company.

THE PHYMOS CHEMICAL LABORATORIES, INC., Pensacola, Fla., has been incorporated with a capital of $45,000 to manufacture chemicals and chemical byproducts. W. J. MacIntire is president; and W. A. Pourtles, secretary and treasurer, both of Pensacola.

THE LEIGHTON CHEMICAL CO., Colchester (Delaware County), N. Y., care of A. G. Patterson, Walton, N. Y., representative, has been incorporated with a capital of $150,000, to manufacture wood alcohol and kindred products. The incorporators are F. Leighton, E. L. White and E. N. Cary.

THE COMMONWEALTH MICA CO., care of the Colonial Charter Co., Ford Building, Wilmington, Del., representative, has been incorporated under Delaware laws, with capital of $1,000,000, to manufacture mica products.

Capital Increases, etc.

THE MERRIAM PAPER CO., Phoenicia, N. Y., has filed notice of increase in capital from $20,000 to $101,000.

THE CONNECTICUT OIL CO., Waterbury, Conn., has arranged for an increase in capital from $150,000 to $250,000 for expansion.

THE FRAZER PAINT CO., 2475 Hubbard St., Detroit, Mich., has filed notice of increase in capital from $100,000 to $250,000.

THE PATTERSON GLASS MFG. CO., Cameron, W. Va., has arranged for an increase in capital from $50,000 to $150,000 for proposed expansion.

THE NEW YORK COLOR & CHEMICAL CO., 12 Gold St., New York, with plant at Belleville, N. J., has filed notice of increase in capital from $100,000 to $350,000.

THE SIEMON HARD RUBBER CORP., Bridgeport, Conn., has filed notice of change of name to the SIEMON CO.

THE TRANSYLVANIA TANNING CO., Brevard, N. C., has arranged for an increase in capital from $25,000 to $1,000,000 for proposed expansion.

THE NATIONAL HELFRICH POTTERIES CO., Evansville, Ind., has increased its capital from $200,000 to $250,000.

THE PETERS PETROLEUM CORP., Tulsa, Okla., is disposing of a preferred stock issue of $2,500,000, a portion of the proceeds to be used for expansion. Charles B. Peters is president.

THE WEST HAVEN RUBBER CO., West Haven, Conn., which recently took over the local plant of Kelley Tire & Rubber Co., is perfecting plans for reorganization, with increased capitalization.

THE UNITED STATES GLASS CO., South 9th and Bingham Sts., Pittsburgh, Pa., is arranging for the sale of a stock issue of $1,000,000, the proceeds to be used for general operations, expansion, etc. Ernst Nickel is secretary.

THE CLINCHFIELD PORTLAND CEMENT CO., Richmond, Va., has arranged for an increase in capital from $2,000,000 to $3,000,000 for general expansion.

THE AMERICAN CORRUGATED PAPER PRODUCTS CORP., 221 West 26th St., New York, N. Y., has filed notice of increase in capital from $300,000 to $500,000 for expansion.

THE INLAND WHITE LEAD CO., 741 Boston Ave., Chicago, Ill., manufacturer of paints, etc., has filed notice of increase in capital from $40,000 to $150,000.

THE SHAFFER OIL & REFINING CO., 208 South La Salle St., Chicago, Ill., is disposing of a note issue of $594,000, a portion of the proceeds to be used for extensions.

THE MIDLAND PAPER CO., 322 West Washington St., Chicago, Ill., has filed notice of increase in capital from $100,000 to $200,000.

THE NEW NIQUERO SUGAR CO., 129 Front St., New York, N. Y., operating sugar refineries, has filed notice of increase in capital from $1,500,000 to $5,000,000 for expansion.

THE GOODALE CO., Kalamazoo, Mich., has arranged for a change of name to the D. R. C. Foundry Co.

THE HUMPHREYS OIL CO., Mexia, Tex., operating oil refineries, has filed notice of increase in capital to $15,000,000 for general expansion.

THE F. E. REED GLASS CO., 860 Maple St., Rochester, N. Y., manufacturer of holloware products, has arranged for an increase in capital from $200,000 to $750,000 for expansion.

Coming Meetings and Events

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual convention in Norfolk, Va., May 7 to 9.

AMERICAN CERAMIC SOCIETY is holding its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold a meeting in Cleveland, O., April 28 to May 4.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its twentieth annual convention at the Greenbrier, White Sulphur Springs, W. Va., June 7, 8 and 9.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

IRON AND STEEL INSTITUTE (London) will hold its annual meeting May 10 and 11 at the House of the Institution of Civil Engineers, London, S. W. 1.

NATIONAL FOREIGN TRADE COUNCIL has postponed its annual conference from April 25, 26 and 27, to May 2, 3 and 4. It will be held in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.